PB-229 846

POLLUTION OF WATERS OF THE UNITED STATES IN LAKE ST. CLAIR, THE DETROIT RIVER, AND WESTERN LAKE ERIE IN THE DETROIT AREA

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

March 1962

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

~~Basic Basin Report~~
TAFT

Reports Section

PB 229 846

POLLUTION OF WATERS

of the

UNITED STATES

in

LAKE ST. CLAIR, THE DETROIT RIVER, AND WESTERN LAKE ERIE

in the

DETROIT AREA

PROPERTY OF:
U.S. DEPT. OF THE INTERIOR
FWPCA - Reference Service
633 Indiana Avenue, N.W.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. Department of Commerce
Springfield VA 22151

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
ROBERT A. TAFT SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

March, 1962

TABLE OF CONTENTS

	PAGE
BACKGROUND	1
THE AREA	7
WATER USES	9
MUNICIPAL WATER SUPPLIES	9
INDUSTRIAL WATER SUPPLIES	10
NAVIGATION	10
RECREATION	10
Boating	11
Water Skiing	12
Swimming	12
Sport Fishing	13
Waterfowl	14
Water Oriented Parks	15
Commercial Fishing	16
WASTE DISPOSAL	16
SOURCES OF WASTES	18
SEWAGE	18
Sewage Plants	18
Lake Front Homes	19
Ships and Boats	20

FROM THE LIBRARY OF THE INTERIOR
U.S. DEPT. OF THE INTERIOR
FWPCA - Reference Service
633 Indiana Avenue, N.W.

TABLE OF CONTENTS
(Continued)

	PAGE
COMBINED SEWER OVERFLOWS	21
INDUSTRIAL WASTES	23
OTHER WASTES	27
Commercial Vessels	28
Dredging Operations	29
CHARACTERISTICS OF WASTES	31
SEWAGE	31
Coliform Bacteria	32
Suspended Solids	37
B.O.D.	38
INDUSTRIAL WASTES	39
Suspended Solids	40
B.O.D.	41
Oil	41
Phenols	42
Ammonia	43
Acid	44
Chlorides	44
Reductions in Industrial Wastes	44

TABLE OF CONTENTS
(Continued)

	PAGE
EFFECTS OF WASTES ON WATER QUALITY AND USES	46
COLIFORM BACTERIA	46
PHENOLIC COMPOUNDS	60
OIL	63
SUSPENDED SOLIDS	66
B.O.D.	68
AMMONIA	69
MISCELLANEOUS FACTORS	70
Carbon Filter Chloroform Extractables . . .	70
Chlorides	71
Hardness	71
Iron	72
Radioactive Wastes	72
SUMMARY AND CONCLUSIONS	74

LIST OF TABLES

TABLE NO.		FOLLOWING PAGE NO.
1	WATER SUPPLIES	10
2	SEWAGE SOURCES AND CHARACTERISTICS	18
3	SOURCES OF INDUSTRIAL WASTES . . .	24
4	INDUSTRIAL WASTE CHARACTERISTICS .	40
5	REDUCTIONS IN INDUSTRIAL WASTES .	44

LIST OF CHARTS

CHART NO.		FOLLOWING PAGE NO.
1	BASE MAP OF AREA - WATER SUPPLIES AND SAMPLING STATIONS	8
2	STORM WATER OVERFLOWS	22
3	COLIFORM BACTERIA - SEWAGE	32
4	SUSPENDED SOLIDS - SEWAGE	38
5	SUSPENDED SOLIDS - INDUSTRIAL WASTES	40
6	COLIFORM BACTERIA AT RIVER RANGES	50
7	COLIFORM BACTERIA - DETROIT AND WYANDOTTE WATER INTAKES	52
8	COLIFORM BACTERIA - WYANDOTTE WATER INTAKE 1951-53 AND 1960-1962 . .	52
9	COLIFORM BACTERIA - DETROIT WATER FRONT	58
10	COLIFORM BACTERIA - EFFECTS STORM OVERFLOWS	58
11	PHENOLS AT RIVER RANGES	62
12	BOTTOM ORGANISMS	66
13	CHLORINE DOSAGES - DETROIT AND WYANDOTTE RAW WATERS	70

POLLUTION OF WATERS OF THE UNITED STATES IN LAKE ST. CLAIR, THE DETROIT RIVER, AND WESTERN LAKE ERIE IN THE DETROIT AREA

BACKGROUND

Pollution of waters in the Detroit area has long been a matter of concern. Nearly 50 years ago a study of pollution of boundary waters between the United States and Canada by the International Joint Commission included the United States waters in the Detroit Area, which are the subject of this report.

That early study was undertaken to determine the causes of high incidences of typhoid fever and other gastroenteric diseases that occurred year after year. At that time all sewage was discharged to the nearest watercourse without treatment. Provisions for treatment of municipal water supplies, consisting of crude attempts at chlorination, were inadequate to cope with the contamination of the sources of water supply by pathogenic bacteria carried in the raw sewage. The reasons for the high incidences of water-borne diseases were obvious. Industrial wastes were of no consequence in those days.

In 1946-1948 the International Joint Commission again included the waters of the Detroit area in a reinvestigation of pollution of boundary waters. The 35 intervening years had

witnessed marked improvements in techniques for treatment of both water and sewage. The municipalities of the Detroit area had taken advantage of the advances in water treatment to provide facilities that had conquered the water-borne epidemics. Some, but not all, of the municipalities had provided sewage treatment. The population of the area, however, had tripled, and the sewage treatment provided had not kept pace with the wastes from the expanding population. Bacterial contamination of the lower Detroit River had approximately tripled. The Area had become highly industrialized, and wastes from the factories had added new dimensions to the pollution problem. The repugnant medicinal tastes of chlorinated phenolic compounds caused recurring complaints by consumers of municipal water supplies. Oils and greases frequently fouled the surface of the waters and occasionally contributed to the death of numbers of ducks. The more subtle effects of toxic chemicals, such as waste acids, ammonia, and cyanides, were suspected in the destruction of fish.

Throughout the years the Michigan Water Resources Commission and the Michigan Department of Public Health have waged a continuing coordinated campaign against pollution of the Detroit area waters by industrial wastes and sewage. These 2 agencies, with their competent staffs of sanitary engineers, have made notable progress in obtaining corrective measures. Representatives of the water departments of both Detroit and Wyandotte report that phenolic contamination no longer exceeds the capabilities of their treatment facilities

to prevent medicinal tastes in the water furnished to consumers. The Water Resources Commission operates a boat to check all sewer outfalls along the Detroit waterfront about 3 times weekly when river conditions permit. These checks are supplemented by observations at points accessible by car, and by periodic aerial surveys. Any abnormal discharge of either sewage or industrial waste is reported to the responsible authorities for immediate investigation and correction. This program has resulted in the detection and early elimination of numerous leaks or spills of both sewage and oil. All municipalities now have sewage treatment plants. The Michigan Department of Health has adopted a policy of requiring chlorination of all sewage plant effluents for bacterial control during the recreational season. This policy applies to effluents of both primary and secondary treatment plants.

In addition to the progress in providing treatment facilities that already has been achieved numerous needed improvements are in immediate prospect. Some of these improvements already are underway, contracts for others have been let, and negotiations regarding still others are proceeding among numerous political jurisdictions of the area.

Despite the very real progress that has been made adverse effects of pollution still plague the Detroit area waters. One municipal water treatment plant draws water from a source with an annual average of monthly median coliform bacterial densities which is about 5 times the objective of 2,400 per 100 ml recommended by International Joint Commission. A popular state park

beach has been closed by the Michigan Department of Conservation. The City of Detroit has prohibited swimming along its waterfront but thousands of persons indulge in water sports on and in water that contains hazardous levels of coliform bacteria. One major city discharges unchlorinated treated sewage and several million gallons per day of raw sewage that bypasses the overloaded plant. The sewerage systems of many municipalities intermittently discharge variable quantities of untreated sewage through storm water overflows from their combined sewers. The sewage from thousands of persons living in shore front homes in areas without sewerage systems is discharged directly to these waters without treatment or with totally inadequate treatment. The untreated sewage from many ships and boats is discharged into the waters. A major duck kill occurred as recently as March, 1960. At least one industry has been unable, despite conscientious effort and the expenditure of considerable money, to find a technical solution to the problem of controlling suspended solids in its waste. Some industries fail to provide gaging, sampling, and analytical programs that are necessary to assure effective control of waste disposal.

The rapidly expanding recreational uses of the Detroit area waters are making increasingly large segments of the public aware of the condition of these waters. Ever increasing numbers of persons engaging in aquatic recreation are being exposed to the inconveniences, damages and health hazards of excessive pollution.

On December 6, 1961, Governor Swainson of Michigan requested Secretary Ribicoff of the U. S. Department of Health, Education, and Welfare to provide assistance in the solution of the existing pollution problems. Governor Swainson's letter included the following:

> "In accordance with Section 8 of P.L. 660 as amended (P.L. 87-88), I request that you, as Secretary of Health, Education, and Welfare, assist the State of Michigan to identify and recommend methods for correcting the sources of pollution going into the Detroit River and subsequently into Lake Erie.
>
> "Michigan's southeastern complex reflects the same type of problem that is reflected in the many other states that have densely populated, rapidly changing metropolitan areas. The Michigan Water Resources Commission, our water pollution control agency, has compiled an exemplary record of pollution abatement throughout the State. However, as is common in highly concentrated industrial areas, critical pollution problems make demands that are above and beyond the normal pollution control activities. It is to this particular problem that we address ourselves and ask for your assistance in order to correct any danger to health and welfare that may exist."

On December 18, 1961, Secretary Ribicoff replied to Governor Swainson as follows:

> "This is in response to your letter of December 6, 1961, requesting action under Section 8 of the Federal Water Pollution Control Act to assist the State of Michigan in correcting sources of pollution coming into the Detroit River and subsequently into Lake Erie.
>
> "We shall be most happy to comply with your request. Our technical staff will be in touch with State representatives to determine with particularity the scope of the problems, and investigations required.
>
> "I am sure that a cooperative State-Federal approach will be of material value in meeting these water pollution control problems of the State of Michigan."

This report represents a broad review of the stream pollution problems in the United States waters of Lake St. Clair, the Detroit River, and the western end of Lake Erie. The review is based on existing data which have been assembled from numerous sources. The report includes such conclusions as are thought to be justified on the basis of information presently available, and suggests areas in which additional investigation is needed.

THE AREA

The waters considered in this report (Chart 1) are on the United States side of the International Boundary between the United States and Canada. The shore line of these waters extends from the mouth of the South Channel of St. Clair River, around the western side of Lake St. Clair, down the Detroit waterfront along the Detroit River, and along the extreme western end of Lake Erie down to the Michigan-Ohio state line.

Four Michigan counties, St. Clair, Macomb, Wayne, and Monroe, have frontage on the waters involved. Detroit, the Nation's fifth largest city, and adjacent areas of the metropolitan complex constitute the land area under consideration.

Sources of municipal and industrial wastes on major tributary streams, as well as those discharging directly to the waters described, are included. On the Clinton River sources of wastes from Pontiac to the mouth are considered. Sources in the entire drainage basins of River Rouge and Ecorse River are included. On the Huron River waste sources from Ann Arbor to the mouth, and on the Raisin River from Adrian to the mouth are considered.

More than half of the population of the State of Michigan resides in this area.

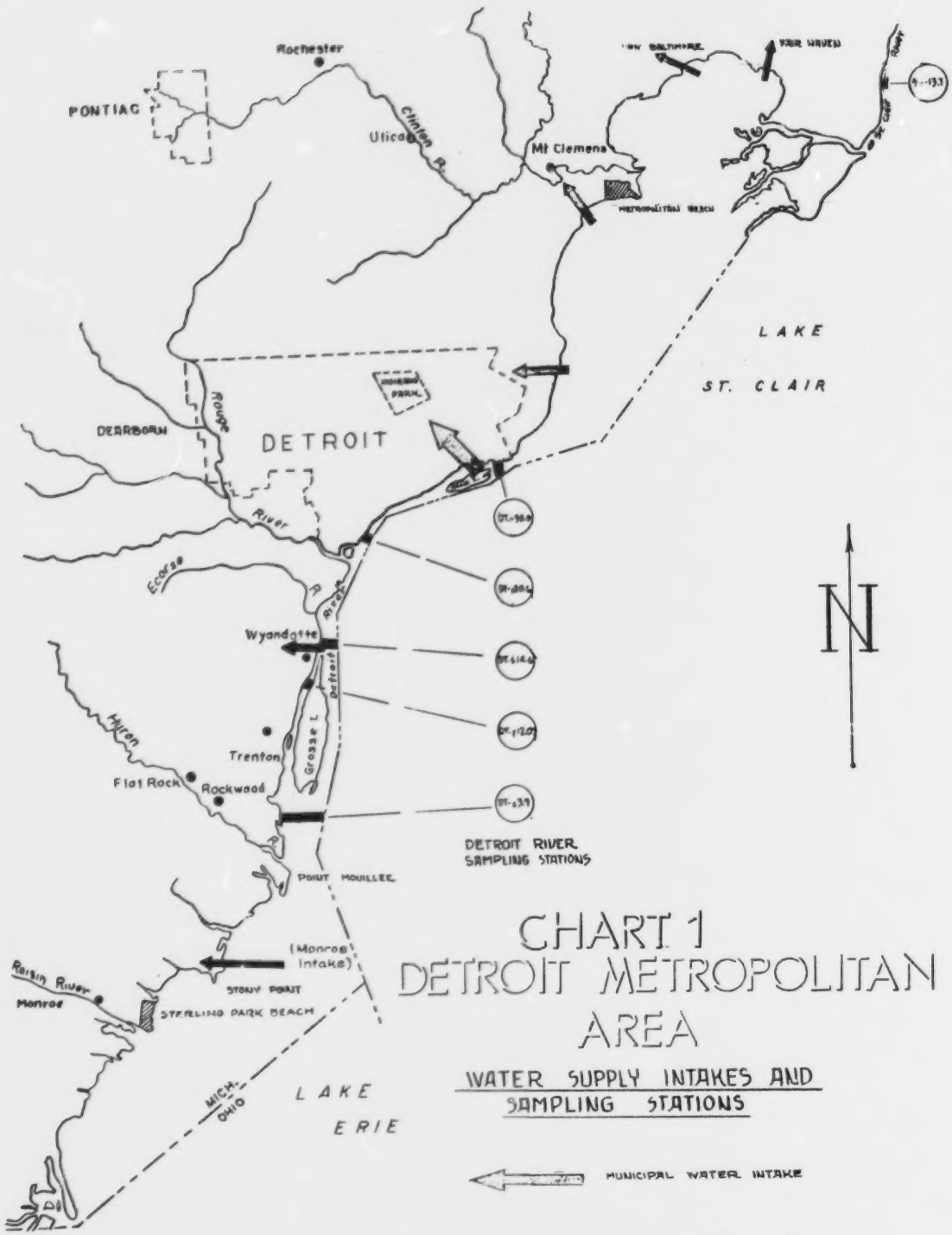


CHART 1
DETROIT METROPOLITAN AREA

WATER SUPPLY INTAKES AND SAMPLING STATIONS

WATER USES

The Detroit area is blessed with an abundance of valuable water resources. The citizens of the area have taken advantage of these resources by putting the waters to almost every conceivable use.

MUNICIPAL WATER SUPPLIES

The use of greatest importance is that as a source of municipal water supply. The locations of the water supply intakes for the 8 municipal water supply systems drawing water from Lake St. Clair, the Detroit River, and Lake Erie are shown on (Chart 1).

Ira Township, New Baltimore, Mt. Clemens, Highland Park, and Grosse Pointe Farms, take water from Lake St. Clair. Detroit and Wyandotte draw water from the Detroit River, and Monroe obtains water from Lake Erie. Several of these systems serve adjacent communities.

The 8 municipalities pump and treat a total of 503 million gallons of water per day, and distribute it to 3,325,000 consumers (Table 1). Of these totals the City of Detroit system, serving

many outlying communities, accounts for 95 per cent of the pumpage and serves nearly 96 per cent of the consumers.

INDUSTRIAL WATER SUPPLIES

Without water to serve its industries the Detroit area would be merely a shadow of the thriving metropolis that it is today.

Detailed information, comparable to that on municipal water supplies, is not available for industrial water supplies. It is estimated however, that industrial supplies pump nearly 1.5 billion gallons per day from the waters under consideration. This quantity is 3 times as much as the municipal supplies use.

NAVIGATION

The great industrial complex of the Detroit area enjoys the advantage of economical transportation of huge quantities of materials by water. A great deal of navigation also traverses the Detroit River in passage to and from other ports both on the Great Lakes and throughout the world.

In a recent year there was a total of more than 28,000 vessel passages on the Detroit River. These vessels transported in excess of 130 million tons of materials, consisting principally of iron ore, coal, grain, limestone, and petroleum products.

RECREATION

Just as the municipal, industrial, and navigational uses of the Detroit area waters contribute substantially to the solid

TABLE 1

MUNICIPAL WATER SUPPLIES

MUNICIPALITY	WATER PUMPAGE mgd	POPULATION SERVED
Ira Township	0.15	2,000
New Baltimore	-	2,040
Mt. Clemens	4.56	25,550
Highland Park	9.89	38,060
Grosse Pointe Farms	3.13	12,170
Detroit	476.6	3,179,000
Wyandotte	5.65	43,520
Monroe	2.94	22,970
	502.92	3,325,310

economic base of the area, the recreational uses of the same waters contribute substantially to the enjoyment of leisure time for an important segment of the population. Swimming, boating and water skiing, fishing, and duck hunting afford pleasure and relaxation for innumerable water sports enthusiasts. The aesthetic value of the waters is attested by the thousands of shore front homes that line the watercourse at intervals from the upper end of Lake St. Clair to the Michigan-Ohio state line below Monroe.

Boating

Pleasure boating in the Detroit area not only is a major recreational pursuit, but it also is big business. In 1961 there were 124,824 registered boats in the 4 principal metropolitan area counties of Macomb, Wayne, Oakland, and Monroe. Available registration figures indicate that only 5 states have more registered boats than the Detroit area. It is estimated that inclusion of boats from 3 other nearby counties and of unregistered boats would increase the total number to between 180,000 and 200,000. It has been said facetiously that on a warm week-end afternoon it would be possible to cross the Detroit River by jumping from boat to boat across the stream.

The estimated value of the boats approaches $260,000,000. It is estimated that more than $60,000,000 was spent in 1961 for new and used boats, motors, accessories, insurance, docking, storage, maintenance, and repairs.

This vast fleet is serviced by an estimated 200 clubs or marinas. The total invested value of these facilities is estimated to be more than $150,000,000. The Memorial Park Marina, built by the City of Detroit, at a cost of $450,000, is completely filled and has a long waiting list of applicants for the 336 mooring spaces. The City anticipates the expenditure of over $1,600,000 on marinas and boat launching ramps in the next 3 years. In St. Clair Shores, on Lake St. Clair, over 3,000 boats are berthed within a one-half mile stretch. Boat service facilities are scattered along the entire water front, but most are concentrated above Belle Isle Bridge.

Water Skiing

There has been a tremendous increase in the popularity of water skiing in recent years. Many of the pleasure boats in the area are used for towing skiers.

The popularity of the sport is indicated by the patronage of a ski school operated by the Huron-Clinton Metropolitan Authority at Metropolitan Beach on Lake St. Clair, where 1,100 persons were trained in 1961.

Swimming

A few examples provide an indication of the popularity of swimming in the waters of the area. At Metropolitan Beach on Lake St. Clair, 533,500 persons used the beach in 1961. An estimated 1,165,500 persons used the beach on Belle Isle in 1961.

This is the southernmost public beach in Michigan on the Detroit River or the western end of Lake Erie that is termed safe for swimming.

Before the Sterling State Park beach, near Monroe, was posted by the Michigan Department of Conservation, attendance at the Park was 1,239,216 in 1959.

Sport Fishing

There is evidence that fishing is an important recreational activity in the Detroit area in both summer and winter. Studies on sport fishing conducted in areas similar to the Detroit area have shown that over 75 per cent of the available boats were used for fishing. On the basis of the estimated number of boats in the Detroit area it appears that between 135,000 and 150,000 may be used for fishing. In the winter fishing shanties dot the ice of Lake St. Clair, where as many as 2,000 have been counted at one time.

The sport fishery of Lake St. Clair has remained fairly stable over the past 30 years. Yellow perch constitute the bulk of the catch. Other species taken include rock bass, walleye, smallmouth bass, crappie, northern pike, bluegill, and muskellunge.

Creel records of the Institute for Fisheries Research, Michigan Department of Conservation, show the species of highly desirable game fish taken in the Detroit River. In order of importance they are yellow perch, white bass, rock bass, walleye,

drum, smallmouth bass, northern pike, smelt, and miscellaneous species. Trap and gill fish studies have yielded 55 per cent game fish, 43 per cent coarse fish, and 2 per cent obnoxious predators. Studies of game fish growth rates* have shown that game fish collected from the Detroit River grew faster than the same species in inland waters of Michigan.

There has been a change in sport fish species taken from Lake Erie in recent years. In 1960 yellow perch comprised 97 per cent of the catch, with small numbers of channel catfish and rock bass. There had been declines, from previous years, in rock bass, bullheads, white bass, walleyes, northern pike, and sheepshead.

Waterfowl

The waters of the area serve as both a flyway stop-over and a wintering area for ducks. During the spring and fall migration period counts have shown approximately 293,000 birds at 1 time on the Detroit River between its mouth and Ambassador Bridge. The mid-winter count of ducks wintering in the Detroit area in 1960 was 123,000. The average wintering count for the past 12 years has been 40,000. The ducks provide sporting pleasure for thousands of hunters during each hunting season.

An indication of the value that Michigan places on this resource is indicated by the 2,600-acre game preserve at the Point Mouillee State Game Area. The estimated land value of this

* Cooper, Gerald P., 1952. The Fish Fauna and the fishing of the Detroit River in vicinity of Sugar and Stony Islands, Mich. Dept. Cons. Report, No. 1350. Typewritten, pp. 37.

game preserve has been reported to be $31,000,000.

Grassy and Mamma Juda Islands have been designated as Federal game refuges.

Water Oriented Parks

Most public parks are centered around some feature of nature that has a strong public appeal. The waters of the Detroit area serve as the focal points for many public parks along the water front, from the Metropolitan Beach near Mt. Clemens on Lake St. Clair to the Sterling State Park near Monroe on Lake Erie.

One of the more important parks is the Metropolitan Beach. This 550-acre park, with improvements that cost $9,000,000, had 1,400,000 visitors in 1960. Facilities are provided for swimming, water skiing and shows, and boat mooring and launching. Over 6,700 boats used its pier-docking facilities in 1960, and 17,500 boats were launched from its ramps.

The marina area in St. Clair Shores, on Lake St. Clair, has mooring facilities for at least 3,000 boats.

Belle Isle Park is on Belle Isle near the upper end of the Detroit River. There were 30,000,000 visitors to this park, of which 1,165,500 visited its beach, in 1960. It has 2 yacht clubs, with 436 boats. There is fishing from the shore.

Opposite Belle Isle on the Detroit water front 3 boat launching and mooring areas are in operation or under construction. St. Gene's boat launching site will have 30 launching ramps.

Engle Park has 28 launching ramps, from which 24,000 boats were launched in 1960. This park will be converted to a 300-boat marina. The Memorial Park Marina, with mooring space for 336 boats, was constructed at a cost of $450,000.

Wayne County operates Ecorse Park near Ecorse River, and Elizabeth Park opposite Grosse Ile. The latter has 3 launching ramps, from which over 9,100 boats were launched in 1961.

The Point Mouillee State Game Area had an estimated 200,000 visitors in 1957.

Sterling State Park, on Lake Erie near Monroe, has 624 acres, on which the state spent over $1,000,000 for land improvements previous to 1960.

Commercial Fishing

No commercial fishing is allowed in Lake St. Clair or the Detroit River. This prohibition reflects the value that is placed on sports fishing in the area.

In Michigan waters of Lake Erie commercial fishing is allowed and provides employment for about 100 men. The annual catch of about 1.5 million pounds has remained fairly constant for the last 30 years. The value of the annual commercial catch is a little more than $100,000.

WASTE DISPOSAL

The waters of the area are used to receive and carry away the sewage, industrial, and other liquid wastes produced by the

varied activities of the population. This necessary and legitimate use generally is practiced with the understanding that its effects must not interfere unduly with other legitimate uses. In the Detroit area waste disposal has taken priority over some other uses.

The Detroit area waters receive about 663 million gallons of sewage and 625 million gallons of industrial process water daily. Wastes discharged directly to the Detroit River include 604 million gallons of sewage and at least 287 million gallons of industrial wastes per day. The River Rouge receives and delivers to the Detroit River about 300 million gallons of industrial wastes daily.

SOURCES OF WASTES

Municipal sewage and industrial wastes are the principal pollutional materials discharged continuously into the waters of the Detroit area. There are other wastes which may be small in quantity, or may be discharged intermittently. Even these may have serious local effects or may cause temporary excessive pollution. Among these wastes are combined sewer overflows, sewage from shore front homes, sewage, garbage, and bilge and ballast water from ships, and materials from dredging operations.

SEWAGE

Table 2 contains information on sources and characteristics of sewage discharged from various sources into the waters of the Detroit area.

Sewage Plants

There are 36 sewage treatment plants in the area. Treatment provided ranges from sedimentation in a septic tank followed by chlorination, to the complete activated sludge process followed by chlorination and sand filtration. All except the Dearborn plant provide chlorination of the effluents for bacterial control,

TABLE 2

SOURCES AND CHARACTERISTICS OF SEWAGE

WATERCOURSE	JURISDICTION	TREAT-MENT	SEWERED POPULATION Sub-totals	SEWERED POPULATION Totals	FLOW mgd	COLIFORM BACTERIA - Billions/day Sub-totals	COLIFORM BACTERIA - Billions/day Totals	BOD - lb/day Sub-totals	BOD - lb/day Totals	SUSPENDED SOLIDS lb/day Sub-totals	SUSPENDED SOLIDS lb/day Totals	TYPE OF SYSTEM
Crappie Creek	New Baltimore	2-Cl		3,100	New plant - No data available							S
Lake St. Clair	St.Clair Co.-Shore Homes	G		4,900	0.24		283,000		686		490	-
	Macomb Co.-Shore Homes	G		2,340	0.13		132,000		328		234	-
Clinton River	Almont	2-Cl	1,250		0.12	34		52		26		SC
	Armada	2-Cl	1,100		0.17	46		33		20		C
	Clintown Twp.-No. 1	2-Cl	8,000		1.13	312		300		289		S
	Clintown Twp.-No. 2	2-Cl	9,000		0.88	243		267		207		S
	Selfridge Field - USAF	No information available - security regulations										
	Mt. Clemens	2-Cl	22,000		2.48	21		575		1,870		C
	Pontiac	2-Cl	75,000		12.9	912		1,820		2,490		SC
	Rochester	1-Cl	5,400		0.90	248		730		540		C
	Romeo	1-Cl	3,300		0.33	91		280		330		SC
	Sterling Twp.-No. 1	2-Cl	9,000		1.17	332		280		330		S
	Sterling Twp.-No. 2	2-Cl	1,400		0.08	22		3		7		S
	Utica	1-Cl	1,450		0.14	40		105		145		C
	Warren Township	2-Cl	90,000		15.9	852		3,150		5,120		SC
TOTALS - CLINTON RIVER BASIN				226,900			3,153		7,595		11,374	
River Rouge	Dearborn - West Plant	1-C	84,000		9.49	6,207,000		5,890		6,020		SC
	Dearborn - Bypassed	None	31,000		3.48	2,280,000		4,450		3,720		
TOTALS - DEARBORN				115,000			8,490,000		10,340		9,780	
Ecorse River	Wayne Metropolitan Airport	2-Cl		-	0.19		1		2		20	S
Huron River	Ann Arbor	2-Cl	90,000		8.5	697		900		549		S
	Belleville	1-Cl	1,900		0.19	52		233		190		S
	Flat Rock	1-Cl	4,600		0.33	1		467		140		SC
	Rockwood	1-Cl	2,000		0.26	55		292		125		C
	Romulus	2-Cl	2,000		0.20	56		34		80		S
	Ypsilanti	1-Cl	20,900		2.52	696		2,100		1,970		SC
	Ypsilanti - Township -No.1	2-Cl	18,000		1.85	510		540		394		S
	Ypsilanti - " " 2	2-Cl	5,000		0.48	134		60		114		S
TOTALS - HURON RIVER				144,400			2,201		4,626		3,562	
Raisin River	Adrian	2-Cl	18,000		2.92	99		30		232		SC
	Blissfield	1-Cl	2,600		0.40	1		165		178		C
	Dundee	1-Cl	2,300		0.13	36		90		96		C
	Milan	2-Cl	4,100		0.52	144		60		100		C
	Monroe	1-Cl	22,900		3.58	81		2,400		1,305		SC
	Saline	2-Cl	2,300		0.16	47		55		67		SC
	Ypsilanti State Hospital	2-Cl	5,000		0.51	148		65		113		S
TOTALS - RAISIN RIVER				57,200			556				2,091	
Lake Erie	Monroe County - Shore Homes	G		3,245	0.16		184,000		465		324	-
Detroit River	Detroit	1-Cl	2,700,000		580	2,900,000		298,000		482,000		C
	Wyandotte	1-Cl	214,000		20.8	150,000		22,300		14,500		SC
	Trenton	1-Cl	19,500		3.18	68,400		3,050		2,760		SC
	Grosse Ile-Naval Air Station	1-Cl	1,000		0.10	28		120		100		C
	Grosse Ile Township - Plant	1-Cl	3,500		0.27	21		420		143		SC
	Grosse Ile Twp.-Septic Tanks	1	2,000		0.10	113,000		280		200		SC
	Wayne County - Shore Homes	G	400		0.02	23,000		56		40		-
	TOTALS - DETROIT RIVER			2,940,400			3,254,449		324,226		499,743	
TOTALS				3,497,485	662.60		12,349,360		348,268		527,618	

Treatment: 1 - Primary; 2 - Secondary; C - Chemical Precipitation; Cl - Chlorination; G - Private homes discharging direct, or with inadequate disposal.

Type of System: S - Separate; C - Combined; SC - Separate and Combined.

at least during the summer when aquatic recreation is prevalent.

The treatment plants serve an estimated total population of 3,484,000. Of this population 2,938,000, or 84.3 per cent, are served by 5 plants discharging directly to the Detroit River. The remaining 546,000 are served by plants discharging to tributary streams. The 5 plants discharging to the Detroit River provide primary treatment followed by chlorination. Of the 31 plants discharging to tributary streams, 18 provide secondary treatment and chlorination. These 18 secondary plants serve 364,000 persons.

The 36 plants discharge a total of 662 million gallons per day of sewage to the area waters. Of this, 604 million gallons per day, or 91.2 per cent, discharge directly to the Detroit River.

In addition to the population served by the 36 sewage treatment plants there are an estimated 2,000 persons on Grosse Ile discharging sewage to several community septic tanks, which are totally inadequate. The effluents from these tanks are not chlorinated.

Lake Front Homes

Many lake front homes are in areas without sewerage systems. The county health departments of St. Clair, Macomb, Wayne and Monroe counties report that thousands of these homes discharge sewage either directly or from inadequate septic tanks

to the nearest body of water. It is estimated that the populations in this category are: 4,900 in St. Clair County; 2,340 in Macomb County; 3,245 in Monroe County; and 400 in Wayne County, for a total of nearly 10,900. The total discharge from these sources is estimated to be 550,000 gallons per day. This quantity is small in comparison with the millions of gallons per day discharged from the sewage treatment plants. The home discharges, however, contain disproportionately high concentrations of coliform bacteria and probably cause excessive local shore line contamination which may spread to adjacent beach areas.

Ships and Boats

Both commercial ships and pleasure boats discharge untreated sewage to the waters of the area. It is estimated that ships discharge sewage equivalent to that from 500 persons daily, and pleasure boats equipped with toilets discharge sewage equivalent to that from 2,700 persons daily during warm week-end days, for a total of 3,200 persons. This is a rather nebulous estimate, and is presented only as an order of magnitude rather than as a firm figure. In addition, such pollution generally is widely distributed over many square miles of water, rather than being concentrated at specific points or along particular shore lines. For these reasons, even though the ensuing bacterial contamination can not be said to be negligible, this source of sewage is not discussed separately in subsequent considerations of the over-all effects of pollution.

COMBINED SEWER OVERFLOWS

Many of the older communities in this country have combined sewer systems. Both municipal sewage and surface runoff following rainfall are collected in the same system of sewers. The quantity of surface runoff frequently is many times that of the normal sewage flow. It is not economical to design sewage treatment plants with the capacities necessary to treat large quantities of runoff. Consequently, systems with combined sewers are designed to bypass portions of the combined sewage and surface runoff when the flows in the systems exceed the capacities of the sewage treatment plants. When overflow occurs quantities of mixed raw sewage and surface runoff discharge through bypass devices to nearby watercourses.

To avoid such raw sewage pollution of receiving waters most modern communities provide separate systems for collecting sewage and surface runoff.

There are a great many combined sewage collecting systems in the Detroit area. Table 2 includes information on the types of systems in the area.

Of the 36 systems listed, 12 have separate sewers, 14 have both combined and separate sewers, and 10 have only combined sewers.

Only 152,400, or 4.4 per cent, of the total 3,484,000 population served by treatment plants are served by completely separate collection systems. The combined systems serve a

population of 2,732,000, or 78.4 per cent of the total. The separate and combined systems serve a population of 599,600, or 17.2 per cent of the total. Thus 95.6 per cent of the sewered population are served by systems which discharge some portion of the raw sewage during periods when rainfall is sufficient to cause discharge through the combined sewer overflow devices.

There are at least 124 storm water overflow points in the Detroit area. Chart 2 indicates the locations of points of combined sewer overflows in the area. These are not necessarily all of the overflow points, but are those identified by governmental offices of the area during this study.

Of the 124 overflow points shown, 50 discharge to the Detroit River, 45 to the River Rouge, 14 to the Clinton River, 11 to Lake St. Clair, 2 to the Huron River and 2 to the Raisin River.

It is difficult to assess the pollutional effects of storm water overflows on receiving waters because there has not been sufficient study of either the characteristics of the overflows or of the effects on receiving waters during periods of overflow to develop factors that may be used in such evaluations.

Most engineering articles dealing with the problem express quantities in terms of percentage of total time that overflow occurs and percentage of total flow of raw sewage that is discharged during overflow. The percentages of total time and flow usually are quite small, and fail to indicate the temporary

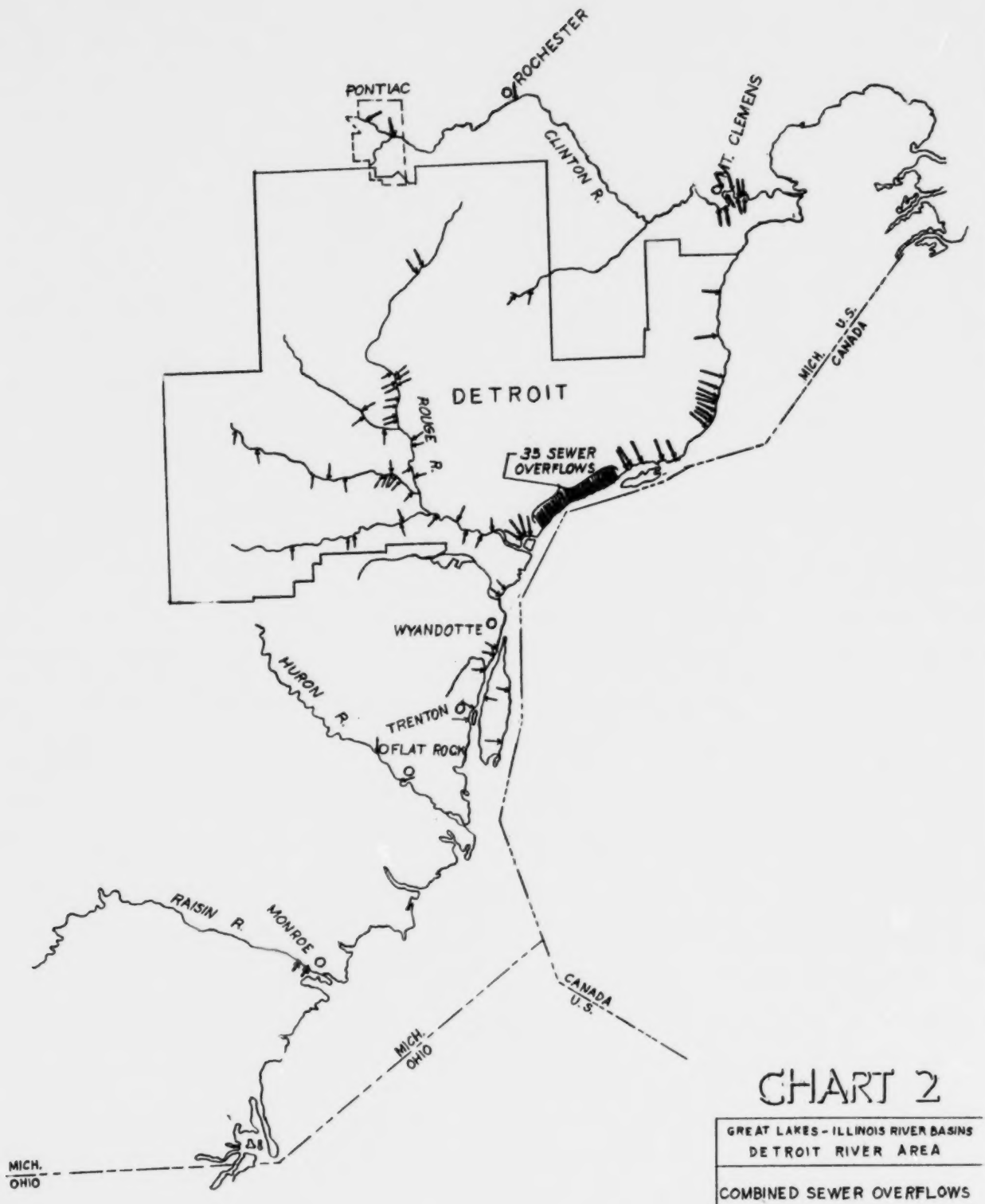


CHART 2

GREAT LAKES - ILLINOIS RIVER BASINS
DETROIT RIVER AREA

COMBINED SEWER OVERFLOWS

DEPT. OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION V CHICAGO, ILLINOIS

magnitude of pollutional discharges during periods when overflows occur.

An article by the Sanitary Engineer of the Detroit Department of Public Works states that overflow from a properly designed combined sewer system occurs about 2 per cent of the total time, and that about 1 per cent of the total sewage flow escapes from the system during that time. If it is assumed that these values apply to the Detroit system, the duration of overflow from the system would average about 175 hours per year. With an average annual sewage flow of 580 mgd in the system the total sewage escaping from the system would be 2,120 million gallons per year. During overflow raw sewage would discharge to the receiving watercourse at an average rate of 12.1 million gallons per hour. Data in the article indicate that the average duration of an individual overflow is about 2 hours. During an overflow of average duration about 24 million gallons of raw sewage would escape to the watercourse. The durations of overflow and percentages of sewage escaping with individual storms vary widely on both sides of the average values cited, depending on intensity and distribution of rainfall.

INDUSTRIAL WASTES

Detroit is not called the "Motor City" without reason. A major portion of the industries in the area are engaged in the manufacture of cars, or of the materials, parts, and accessories that go into the manufacture of cars. Another sizeable segment

of the industry of the area is devoted to the production of heavy chemicals from the extensive underground salt deposits.

Table 3 lists the industries of the area by name and location, and indicates the types of products manufactured. The table includes information on types of treatment or other control measures provided for the wastes. The table does not include data on sewage from plant employees. In many cases the sewage is discharged to nearby municipal sewers, and is considered to be accounted for in Table 2 on sources of sewage. In some cases the industries provide treatment plants for the plant sewage. In such cases it is assumed that at least a majority of plant employees live in surrounding sewered communities and likewise are accounted for in Table 2. It is reported that the sewage from all plants is disposed of adequately by 1 of the 2 methods.

Table 3 lists only those plants that discharge industrial wastes directly to nearby watercourses. Industries which discharge wastes to municipal sewerage systems are not included, since satisfactory disposal of these wastes is the responsibility of the municipalities involved.

The tabulation does not include information on the characteristics of the industrial wastes. Review of available records and files and visits to selected plants revealed that reliable, recent data on volumes and constituents of many of the wastes were lacking. Under existing circumstances it is thought to be inexpedient to pinpoint certain industries for which data are available, while at

TABLE 3

SOURCES OF INDUSTRIAL WASTES

PLANT OR PLANT DIVISION	LOCATION	PRODUCT OR OPERATIONS	WASTE TREATMENT OR CONTROL
		CLINTON RIVER	
Briggs Manufacturing Company	Sterling Township Macomb County	Enameled Steel Bath Tubs	Sedimentation pickle liquor disposed of by outside contractor.
Thompson Products, Inc.	Warren		Air flotation and ponds.
Chrysler Corporation			
Defense Operations Div.	Centerline	Army Ordnance, Electroplating	Chemical treatment of electroplating wastes.
Michigan Missile Plant	Sterling Township Macomb County	Naval Industrial Reserve Plant	Chemical treatment of electroplating wastes. Effluent records available.
Parts Plant	Centerline		
Ford Motor Company			
Chasis Parts Plant	Sterling Township Macomb County		Holding Lagoon. Soluble oil treatment.
Engineering Proving Ground	Bruce Township Macomb County		
Standard Tube Company	Redford Township Wayne County		Waste Lagoon. Oil burned off. No surface discharge.
National Machine Products	Utica		Oil Separator.
		ROUGE RIVER	
Trilex Corporation	Canton Township Wayne County	Electroplating	Wastes neutralized and discharged to pond. Sludge removed from pond. Oil skimmer on pond. Chromium reduced and cyanide oxidized.
Ford Motor Company			
Lincoln - Mercury Division	Wayne County		
Evans Products Company	Plymouth		
General Motors			
Detroit Diesel Engine Div.	Detroit		Oil Separator on storm water drain.
Darling & Company	Melvindale	Dry process rendering plant.	Waste control by housekeeping. Fat separator.
Ford Motor Company			
Rouge Plant	Dearborn		
Miller Road		Iron Foundry	Sedimentation and Oil Separator.
Gate 11		Rolling Mill	Sedimentation, oil skimmed and demulsified.
Roula Creek		Blast Furnace, Engine Plant	Oil Skimmer. Soluble oil treatment. Clarifiers.
Tailrace Outlet		Steel Pickling, Coke Plant	Deep well disposal.
Peerless Cement	Detroit		Not Operating.

TABLE 3
(Continued)

SOURCES OF INDUSTRIAL WASTES

PLANT OR PLANT DIVISION	LOCATION	PRODUCT OR OPERATIONS	WASTE TREATMENT OR CONTROL
		ROUGE RIVER	
Fuel Oil Corporation	River Rouge	Distribute fuel oil	Vessel washings to pond. Pond water passed through oil separator.
Allied Chemical Corporation General Chemical Division		Sulfuric Acid and Alum	Waste stream monitored by pH Recorder.
Solvay Process Division	Detroit	Soda Ash	
Plastics Division	Detroit	Tar Pitches and Oils	Waste stream, dephenolized waste and yard drainage to sedimentation and oil separation. Effluent sampled at 10-minute intervals in proportion to flow, and analyzed.
Peerless Cement	Detroit	Portland Cement	Dust electric precipitators.
Scott Paper Company	Detroit	Paper Products	White water and screened wastes discharged to small pond for sedimentation.
		HURON RIVER	
Belleville Plating Company	Belleville	Electroplating	Electroplating operations in curbed area. Chemical treatment of wastes.
General Motors Corporation Fisher Body Division	Willow Run	Auto Bodies	Chemical coagulation and sedimentation. Sludge vacuum filtered.
D. T. & I. Ry.	Flat Rock	Railroad Yard	Oily wastes and yard drainage treated by aeration and sedimentation.
		RAISIN RIVER	
Dundee Cement Company	Dundee	Portland Cement	Quarry wastes cascaded for aeration and removal of H_2S.
Monroe Paper Products	Monroe		Chemical coagulation and sedimentation.
Consolidated Paper Company West Side South Side North Side	Monroe	Asphalt Board Automotive blackboard, box board Strawboard, liner board	Chemical coagulation and sedimentation. Sedimentation and sludge lagooning. Sedimentation of part of waste streams.
Ford Motor Company	Monroe	Bumpers	Chemical treatment of electroplating wastes and dilution.
Union Bag-Camp Corporation	Monroe	Container board	Coagulation and sedimentation.
		DETROIT RIVER(Above Wyandotte Water Plant Intake)	
U. S. Rubber Company	Detroit	Auto Tires	Industrial wastes to City sewer.
Anaconda American Brass Company	Detroit	Copper tubes, rods, and sheets	Pickle liquor automatically neutralized. pH of effluent recorded.
Revere Copper and Brass, Inc.	Detroit		Oil separators. Pickle liquor diluted before discharge.
Allied Chemical Corp. Semet-Solvay Division	Detroit	Coke, ammonia liquor, tar & oils	Dephenolize ammonical liquor.
Great Lakes Steel Corp. Blast Furnace Division	River Rouge	Blast furnaces and coke plant	Dephenolize ammonical liquor, and use portion to quench coke. Sedimentation of blast furnace washer water.

24-B

TABLE 3
(Continued)

SOURCES OF INDUSTRIAL WASTES

PLANT OR PLANT DIVISION	LOCATION	PRODUCT OR OPERATIONS	WASTE TREATMENT OR CONTROL
		DETROIT RIVER (Above Wyandotte Water Plant Intake)	
Allied Chemical Corporation Solvay Process Division	Detroit	Soda Ash	Slurries are settled in cones and sludge impounded.
Great Lakes Steel Hot Strip Rolling Mill	River Rouge	Sheets	Sedimentation and oil separation.
Dana Corporation	Ecorse	Automobile Frames	Waste pickle liquor hauled away.
Great Lakes Steel Ecorse Mill	Ecorse	Sheets, bars, rods, shapes	Oil Separators. Scale sedimentation.
E. I. du Pont de Nemours & Co.	Ecorse	Sulfuric Acid	pH of waste stream recorded.
		DETROIT RIVER (Below Wyandotte Water Plant Intake)	
Archer-Daniels-Midland Company	Wyandotte	Hydrogenated Oils	Oil Separator.
Wyandotte Chemical Corporation	Wyandotte	Caustic soda, soda ash, coke, ammonia, glycol, polyesters	Coke Oven and concentrated wastes are settled in lagoons before discharge. Grab samples taken and analyzed on routine basis.
Pennsalt Chemicals Corporation Industrial Chemicals Div.	Wyandotte	Chlorine, caustic soda; ammonia hydrogen, peroxide, ferric chloride	
Firestone Tire & Rubber Company Firestone Steel Prod. Div.	Riverview	Steel rims, metal stampings	Oil separator effluent discharged to ponds in series. Dispersion Outfall.
Pennsalt Chemicals Corporation Organic Chemicals Div.	Riverview	150 organic chemicals	Some wastes are lagooned. All wastes through Oil Separator. Wastes sampled.
McLouth Steel Corporation	Trenton	Blast furnaces and rolling mill	Neutralization of pickle liquor, coagulation, sedimentation, and sludge filtration. Effluent records available. Oil Recovery.
Mobil Oil Company	Trenton	Gasoline, light oils	Phenol wastes lagooned. All wastes and drainage through oil separator, and air flotation. Sludge vacuum filtered.
Monsanto Chemical Company	Trenton	Phosphates	Wastes pass through ponds.
Shawinigan Resins	Trenton	Polyvinyl butyral	
		LAKE ERIE	
Detroit Edison Company Enrico Fermi Station	Monroe	Electricity	Special Facilities Provided.

D-45

the same time omitting other industries for which data are incomplete but which may be significant contributors of pollution. All of the analytical data available have been totaled for individual river basins or for selected sections of receiving waters, and are presented subsequently in this report.

Table 3 lists 56 plants in the Detroit area which discharge process wastes directly to the waters of the area. The total quantity of wastes for which estimates on flow are available is 625 million gallons per day.

Nine plants are situated in the Clinton River Basin in or below Pontiac. The plants processes are principally metal working or finishing. The 3 million gallons per day of wastes contain relatively small quantities of oxygen demanding materials, suspended solids, oil, iron and cyanide. All have some form of waste treatment or control.

There are 17 plants located on the River Rouge or its tributaries. The principal products are steel, fabricated metals, heavy chemicals, pulp and paper, and cement. The plants produce a total of 300 million gallons per day of wastes. Principal waste constituents are oxygen demanding materials, suspended solids, oils, waste pickle liquor, phenols and ammonia. Most of the plants have some type of waste treatment or control, but there are oil spills from time to time, and some waste pickle liquor is discharged without treatment. The total quantities of oxygen demand, suspended solids, phenols, and ammonia of the combined wastes are large.

Three industries discharge directly to the Huron River or its tributaries below Ypsilanti. Two are metal finishing plants and the third is a railroad yard. Total wastes are 0.5 million gallons per day. All 3 plants are said to have adequate treatment.

The Raisin River receives wastes from 7 plants in the vicinity of Monroe. Total waste discharge is 34 million gallons per day. Five of the plants are pulp and paper mills. One plant electroplates metals and the other produces cement. Waste constituents include large quantities of oxygen demanding material and suspended solids. Smaller quantities of toxic metallic ions and hydrogen sulfide are discharged. Wastes from one of the pulp and paper mills is reported to contain large numbers of coliform bacteria. Most of the pulp and paper wastes are settled for suspended solids reduction and the other two plants provide appropriate treatment.

Ten industrial plants discharge directly to the Detroit River above the Wyandotte water treatment plant. Total waste discharge is about 156 million gallons per day. The plants manufacture metals, including rolled steel, copper and brass products, and coke and heavy chemicals. Principal waste constituents are oxygen demanding materials, suspended solids, oils, waste pickle liquor and other acids, chlorides, phenols, and ammonia. Most of the waste pickle liquor receives only such neutralization as is provided by the natural alkalinity of the

river water. Two plants dephenolize coke plant wastes, 3 have oil separators, 1 provides automatic acid neutralization, and some reduce suspended solids by sedimentation.

Nine plants discharge directly to the Detroit River below the Wyandotte water treatment plant intake. Total waste discharge is about 131 million gallons. The plants manufacture steel, fabricated metals, heavy chemicals, organic chemicals, refined petroleum oil products, hydrogenated oils, phosphates, plastics and cement. Waste constituents include oxygen demanding materials, suspended solids, waste pickle liquor, oils, dissolved iron, chlorides and phenol. Common waste treatment methods are oil separation, and ponding for sedimentation and controlled waste discharge.

The single industrial plant discharging directly to the western end of Lake Erie is the new nuclear power plant near Monroe. This plant is not yet in operation.

OTHER WASTES

Wastes that have not been discussed thus far are difficult, without detailed investigation, to estimate quantitatively or to evaluate in terms of effects on water quality and uses. The effects of such wastes generally are relatively minor in relation to the large quantities of sewage and industrial wastes that are discharged continuously.

Commercial Vessels

Sewage from ships and boats has been discussed previously. Review of vessel passages and routes on the Detroit, and availability of port garbage disposal facilities, indicates that there were nearly 5 overseas vessels per day in the summer of 1961 which might have dumped garbage in the Detroit River. If all of these vessels had dumped the garbage which accumulated between ports, the total is estimated to be 3,400 pounds per day. The actual total dumped is believed to be considerably less than this.

The foregoing does not include lake vessel passages, for which less information is available. There were about 6 times as many lake vessel passages as there were oversea vessel passages.

In the 1951 International Joint Commission report it was estimated that total garbage dumped in the lower Lake Huron to upper Lake Erie waters at the peak of the navigation season might be about 2,000 pounds per day.

In addition to garbage which may be dumped from commercial vessels litter is thrown overboard by thoughtless pleasure boaters.

Commercial vessels also may dump bilge and ballast waters in areas where such waters can cause adverse local conditions. Bilge water usually contains oil and greases. Ballast water may be either reasonably clean or highly polluted, depending on the

area from which it is taken on board. The 1951 International Joint Commission report estimated that possibly 40 gallons of oil per day might be discharged with bilge water. No reasonable estimate of either quantity or quality of ballast water was considered feasible.

Dredging Operations

The lower 3 miles of the River Rouge is dredged annually by the Corps of Engineers, usually in late fall, to maintain the navigation channel. The settled material which must be dredged consists of a mixture of sewage and industrial waste solids with alluvial deposits. In 1948 the Public Health Service made a special study of the effects of the dredging on water quality below both the mouth of the River Rouge, and the dumping area, which at that time was upstream from the western edge of Fighting Island. The dredged material dumped each day, for 46 days, averaged: 62,300 pounds of B.O.D.; 650,000 pounds of volatile solids; 32,600 pounds of iron oxide; 2,710 pounds of sulfides; and 17,400 gallons of oil. The material contained large quantities of coliform bacteria. These data reflect the heavy load of pollution carried by the River Rouge. Examination of the Detroit River showed marked increased in coliform bacteria for several miles downstream along the shore below the mouth of River Rouge, and below the dumping site. There were moderate increases in chlorides and turbidity in the same areas. At present the dredged material is hydraulically pumped into a diked area

surrounding Grassy Island. No data on the effects of this method of disposal on downstream water quality have been obtained, but no complaints are known to have resulted from the present practice.

The 1948 special report of the Public Health Service noted that the Corps of Engineers, in the discharge of its delegated duties for maintenance of navigable channels, was not primarily responsible for the pollution that resulted from its dredging operations. The report concluded that the primary responsibility was with the municipalities and industries that discharged inadequately treated sewage and industrial wastes into the River Rouge.

The Corps of Engineers also conducts dredging operations in the lower Detroit River and in Lake Erie. The dredged material is transported to dumping areas offshore from Point Mouillee.

CHARACTERISTICS OF WASTES

In the preceding section wastes were discussed in terms of sources, volumes and methods of treatment. In this section sewage, industrial wastes and storm water overflows are described in terms of quantities of pollutional constituents insofar as available records or reasonable assumptions and estimates permit.

SEWAGE

The pollutional characteristics of sewage from treatment plants and shore homes are included in (Table 2). The constituents chosen to describe the characteristics of the sewage are coliform bacteria, suspended solids, and 5-day biochemical oxygen demand (B.O.D.). The treatment plant operating records in the files of the Michigan Department of Health provided most of the data. In a few cases it was necessary to estimate flows, the most probable numbers (MPN) of coliform bacteria, B.O.D., or suspended solids of sewage discharges. Since the characteristics of domestic sewage and its response to treatment are

everywhere so similar the estimates could be made with reasonable assurance. Estimates generally were necessary for only the smaller discharges.

Generally the data are for the period of May through October, 1961. This period was chosen because the data were the most recent available in the Department of Health files and because it covered the period when recreational use of the waters is greatest.

Chart 3 depicts the relative quantities of coliform bacteria from the more important sources. The areas of the circles are in proportion to the quantities from the various sources.

Coliform Bacteria

The mean numbers of coliform bacteria discharged daily have been calculated, in billions, from the data on MPN's and flow. The total number of coliform bacteria in all continuous sewage discharges was computed to be 12,350,000 billion per day. This number represents only a little more than 3 per cent of the estimated coliform bacteria in the untreated sewage from all sources. This indicates an over-all reduction by treatment of about 97 per cent in raw sewage bacteria.

The Dearborn treatment plant effluent plus the bypassed raw sewage was by far the largest contributor of coliform bacteria to the waters of the area. This plant accounted for 8,490,000 billion per day, or 68.8 per cent of the total. When this plant is connected to the Detroit system the coliform bacteria discharged

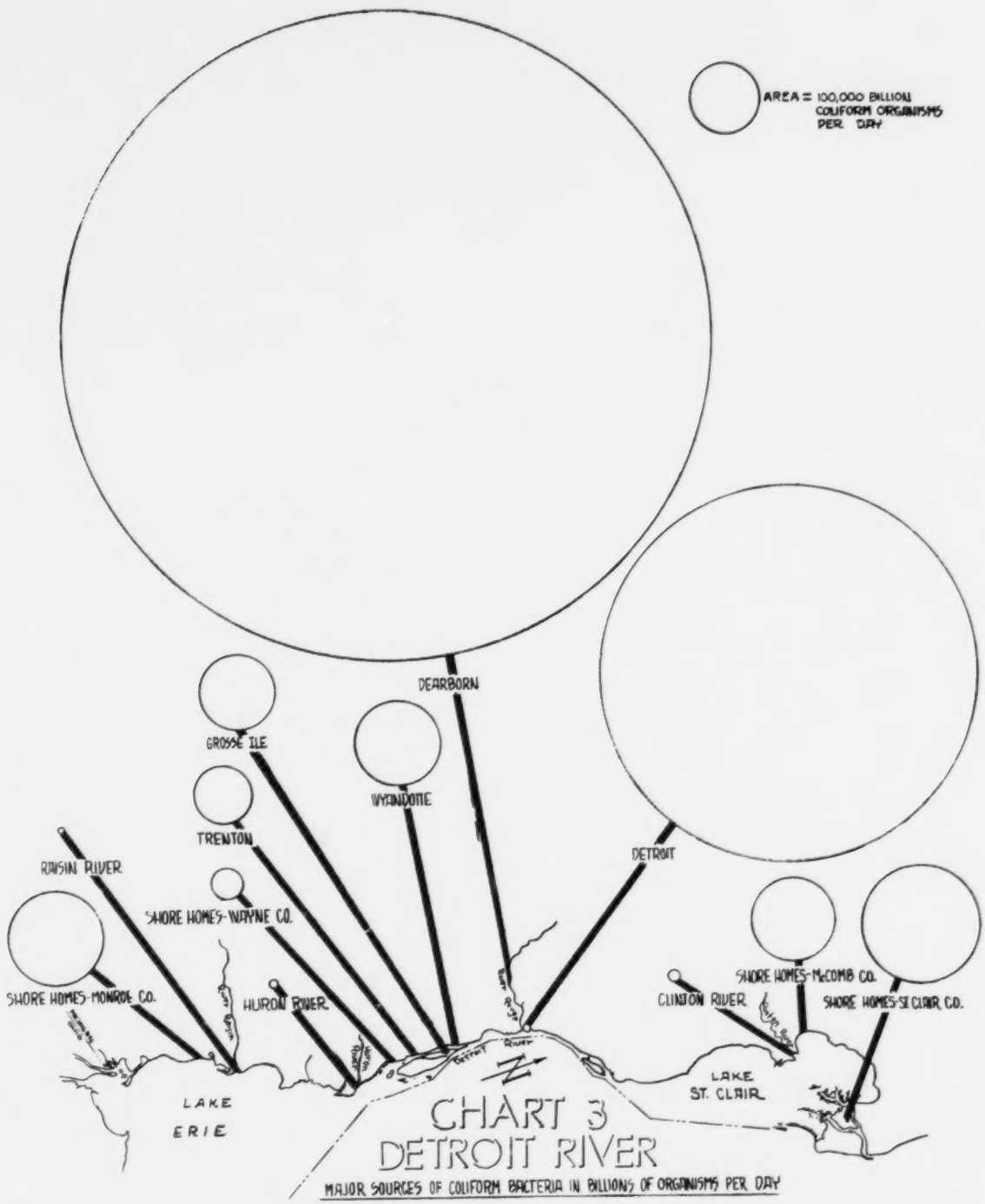


CHART 3
DETROIT RIVER

MAJOR SOURCES OF COLIFORM BACTERIA IN BILLIONS OF ORGANISMS PER DAY

daily from all sources should be reduced to an estimated 1 per cent of the total in all raw sewage, for an over-all reduction of about 99 per cent.

The second largest contributor was the Detroit sewage treatment plant effluent, with an estimated 2,900,000 billion coliform bacteria per day, or 23.5 per cent of the total. The Dearborn and Detroit plants together contributed an estimated 92.3 per cent of the total for the entire area.

The reliability of the data cited for the Detroit plant is subject to question. During 1961 personnel of the Detroit plant noted a lack of correlation between coliform data on the chlorinated effluent and on river samples collected below the point of effluent discharge. Investigation revealed that coliform densities of samples of chlorinated effluent collected from the regular laboratory sampling tap were several times greater than the densities of samples collected from a newly installed pitcher pump. In addition, the laboratory tap samples frequently contained no chlorine residual, whereas the pitcher pump samples generally had some residual chlorine. The laboratory tap samples were pumped through a long line from the effluent outfall to the laboratory tap. The sewage was in transit through the sample line for about 10 to 15 minutes, during which time it was in contact with such biological slimes as might develop on the interior walls of the line. The pitcher pump samples, drawn from the same location on the effluent outfall, were in contact with the walls of the pump

suction line for a much shorter time.

Coliform determinations were made on about 60 duplicate samples from the laboratory tap and the pitcher pump during a two-month period. A statistical correlation was developed between the 2 sets of data.

Following this investigation the chlorinated effluent coliform data originally reported to the Department of Health were judged to be in error from November 1, 1960, through August 22, 1961, and for the first 18 days in October, 1961. The coliform data for those 2 periods were adjusted on the basis of the correlation between the laboratory tap and the pitcher pump data.

In a letter dated August 21, 1961, Detroit officials notified the Michigan Department of Health of the presumed error in the chlorinated effluent coliform data. A letter dated January 5, 1962, submitted the adjusted data to the health department with a statement that the new data were believed to reflect the true quality of the plant effluent.

The adjusted data are the basis of the estimated 2,900,000 billion coliform bacteria per day discharged to the Detroit River in the Detroit treatment plant effluent. If the data originally reported to the health department were used, the computed discharge would be almost exactly 10 times this number, or 29,400,000 billion per day. The latter value would be nearly 3.5 times the estimated Dearborn discharge.

The overloaded Wyandotte treatment plant was the third largest single contributor, with 150,000 billion coliform bacteria per day, or 1.2 per cent of the total from all sources. Trenton was the fourth largest individual source, with 68,000 billion, or about 0.55 per cent.

The numbers of coliform bacteria discharged to tributary streams other than the River Rouge were quite small in comparison with the numbers for Dearborn, Detroit, Wyandotte, and Trenton. The total estimated for the Clinton River was 3,150 billion coliform bacteria per day, for the Huron River 2,200 billion per day, and for the Raisin River 560 billion per day. The combined total for the 3 river basins was 0.04 per cent of the total for the entire area. The sewage treatment plants discharging to these 3 tributary streams served a combined population of 428,500, or 12.2 per cent of the total sewered population in the Detroit area. The fact that about one-eighth of the population contributed less than one-half of 1 per cent of coliform contamination reflects the generally higher degrees of treatment, and the more effective chlorination practices of plants located on these tributaries.

A comparison of densities of coliform bacteria in treatment plant effluents also is revealing. Records of effluent coliform densities for 10 plants on the tributary streams are available. The average MPN for the effluents of the 10 plants was 1,330 per 100 ml. This contrasts with the adjusted average MPN of the

Detroit plant effluent of 136,000 per 100 ml. The average of the monthly values originally reported to the Department of Health by Detroit was 1,350,000 per 100 ml. The average MPN of the unchlorinated Dearborn effluent was 17,100,000 per 100 ml.

The relatively small populations of the shore homes of the 4 waterfront counties contributed a surprisingly large estimated number of coliform bacteria. The combined population of nearly 11,000 contributed an estimated total of 622,000 billion coliform bacteria per day, with: 283,000 billion from St. Clair County; 132,000 billion from Macomb county; 184,000 billion from Monroe County; and 23,000 billion from Wayne County. The 2,000 population on Grosse Ile, which contributed an estimated 113,000 billion coliform bacteria through inadequate septic tanks, may be considered in the same category as the shore front homes. This addition brings the Wayne County contribution from such sources to 136,000 billion, and increases the shore homes total contribution to an estimated 735,000 billion per day. This 5.95 per cent of the estimated total for the entire area was contributed by less than 0.4 per cent of the sewered population. It is nearly 15 times the combined total for the effluents from the Clinton, Huron, and Monroe river basin treatment plants, serving a combined population of 428,500, and is nearly one-third of the estimated contribution of the Detroit treatment plant.

It is instructive to consider the probable magnitude of coliform bacteria contributions by storm water overflows. Using

the Detroit system as an example, it was estimated previously that 24 million gallons of raw sewage overflowed directly to the river during an average two-hour storm. The average coliform MPN of the Detroit primary tank effluent, before chlorination, was 15,100,000 per 100 ml during May through October, 1961. A representative of the treatment plant laboratory stated that the coliform densities of the raw and settled sewage were essentially the same. On this basis, the average storm would result in the discharge of 13,700,000 billion coliform bacteria to the Detroit River in 2 hours. This is more than the total discharged from all sources for an entire day, and is about four and three-quarters times the estimated daily Detroit contribution.

Suspended Solids

Chart 4 depicts the relative contributions of sewage suspended solids to the waters of the metropolitan area. The areas of the circles are in proportion to the loads from the various plants.

The total from all sources was estimated to be nearly 528,000 pounds per day, or 264 tons. Of this nearly 500,000 pounds per day, or almost 96 per cent, were discharged to the Detroit River.

The Detroit treatment plant effluent accounted for 482,000 pounds per day, or 91.3 per cent of the total. The Wyandotte treatment plant contributed 14,500 pounds per day, or 2.75 per cent. The third largest contribution was from the combined plants on the

Clinton River, with 11,400 pounds per day, or nearly 2.2 per cent of the total. The Dearborn treatment plant effluent and the by-passed raw sewage accounted for 9,780 pounds per day, or about 1.85 per cent. All other sources combined contributed a little less than 1.9 per cent of the total.

B.O.D.

No indication has been found that oxygen depletion of the waters of Lake St. Clair, the Detroit River, and the western end of Lake Erie is a problem.

The B.O.D. data in (Table 2), therefore, are not presented as an indication of a direct effect on a particular parameter of water pollution, but rather as another measure of relative quantities of sewage constituents discharged from the various sources.

The total 5-day B.O.D. from all sources of sewage was 348,000 pounds per day.

Of this, 324,000 pounds per day, or 93 per cent, were discharged directly to the Detroit River. The Detroit treatment plant accounted for 298,000 pounds per day, or 85.5 per cent. The Wyandotte treatment plant discharged 22,300 pounds per day, or 6.4 per cent.

The third largest contributor was the Dearborn plant, with 10,340 pounds per day, or nearly 3 per cent. All treatment plants combined on the Clinton River discharged 7,600 pounds per day, or nearly 2.2 per cent. All other sources combined contributed 10,000 pounds per day, or nearly 2.9 per cent.

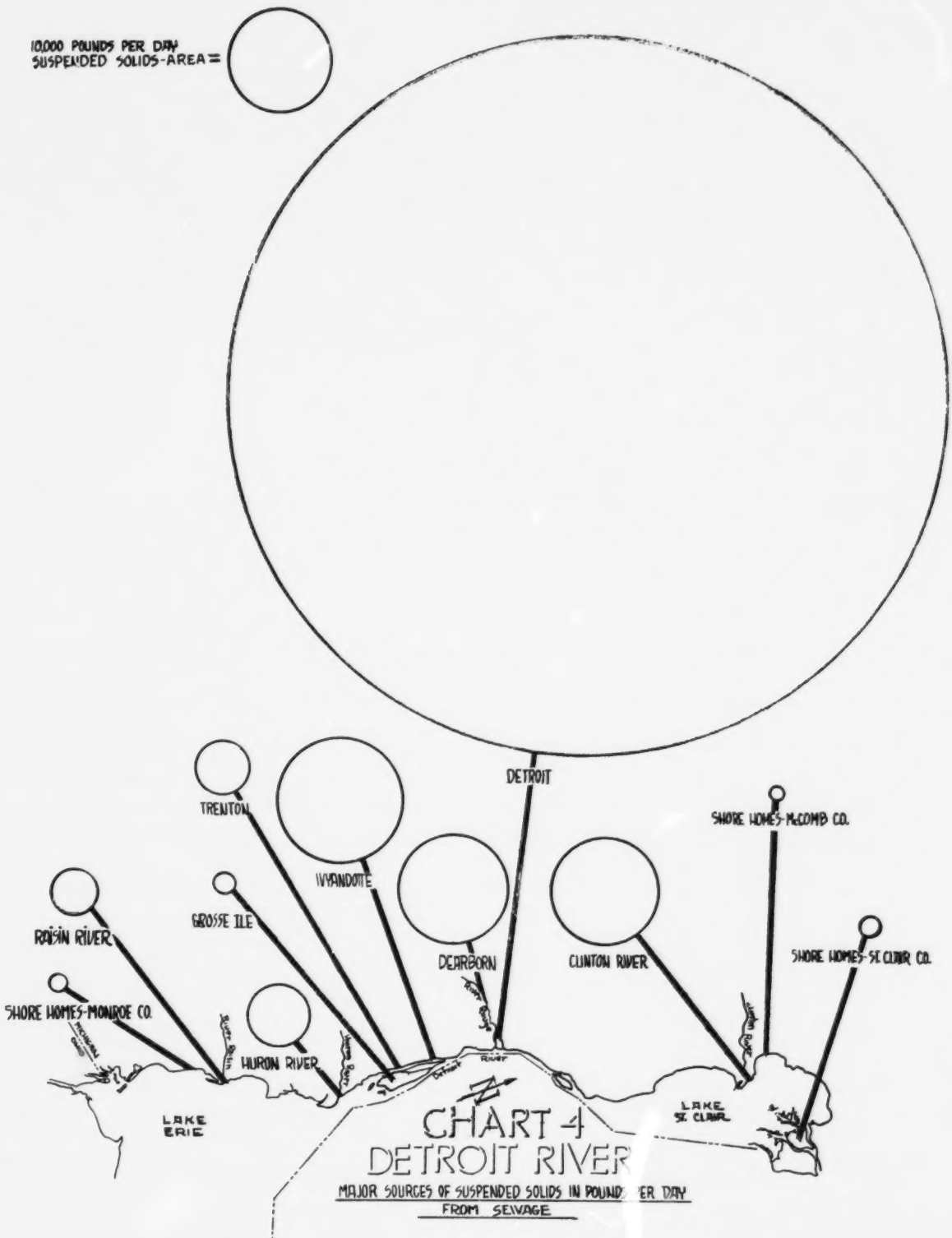


CHART 4
DETROIT RIVER

MAJOR SOURCES OF SUSPENDED SOLIDS IN POUNDS PER DAY FROM SEWAGE

INDUSTRIAL WASTES

Industrial wastes frequently are more complex and diverse and more difficult to characterize than is sewage. Two of the parameters applied to sewage, suspended solids and B.O.D., are applicable to many industrial wastes. A few industrial wastes contain coliform bacteria. None of these 3 parameters apply to some industrial wastes, and the wastes may contain almost innumerable constituents that are not commonly found in sewage.

In the Detroit area the principal characteristics of most industrial wastes discharged directly to adjacent waters may be described in terms of suspended solids, B.O.D., oil, phenols, ammonia, acid, chlorides, hardness constituents, iron, and toxic ions in plating and metal finishing wastes such as cyanide, chromium, copper, and a few other metals.

Not all of these parameters apply to the wastes from any single plant. No quantitative data are available for some wastes which are known to contain certain of the constituents.

It appears expedient, as stated previously, to discuss combined totals of selected constituents for all plants in specified areas rather than to attempt to pinpoint individual plants.

Table 4 incorporates total constituents for the river basins under consideration, and for the upper and lower Detroit River.

Suspended Solids

The data available indicates that about 500,000 pounds per day of suspended solids were discharged by industry to the waters of the metropolitan area. This quantity is only slightly less than the total 528,000 pounds per day from all sewage treatment plants. The sewage and industrial wastes together contributed over a million pounds per day, or more than 500 tons, of suspended solids.

Of the 500,000 pounds per day total in industrial wastes, 380,000 pounds per day, or 76 per cent, were discharged directly to the Detroit River, with 100,000 pounds per day entering above and 280,000 pounds per day below the Wyandotte water plant intake, as shown on (Chart 5).

The 80,000 pounds per day, or 16 per cent, discharged to the River Rouge was the second greatest contribution. The Raisin River received 38,000 pounds per day, or 7.6 per cent of the total.

The Clinton River received 1,000 pounds per day, and the Huron 50 pounds per day.

A total of 880,000 pounds per day, or 69.5 per cent, of the total from both sewage and industrial wastes, was discharged directly to the Detroit River.

TABLE 4

CHARACTERISTICS OF INDUSTRIAL WASTES

STREAM	FLOW mgd.	CONSTITUENTS IN POUNDS PER DAY				
		PHENOL EQUIVALENTS	OIL	SUSPENDED SOLIDS	5-DAY BOD	AMMONIA (as N)
Clinton River	3	-	100	1,000	100	-
Rouge River	300	700	>4,000	80,000	200,000	1,000
Huron River	0.5	-	-	50	-	-
Raisin River	34	-	-	40,500	48,000	-
Detroit River						
Above Wyandotte Intake	156	250	>1,200	100,000	-	750
Below Wyandotte Intake	131	245	>2,000	280,000	4,000	8,000
TOTALS	624.5	1,195	>7,300	501,550	252,100	9,750

4.1.A

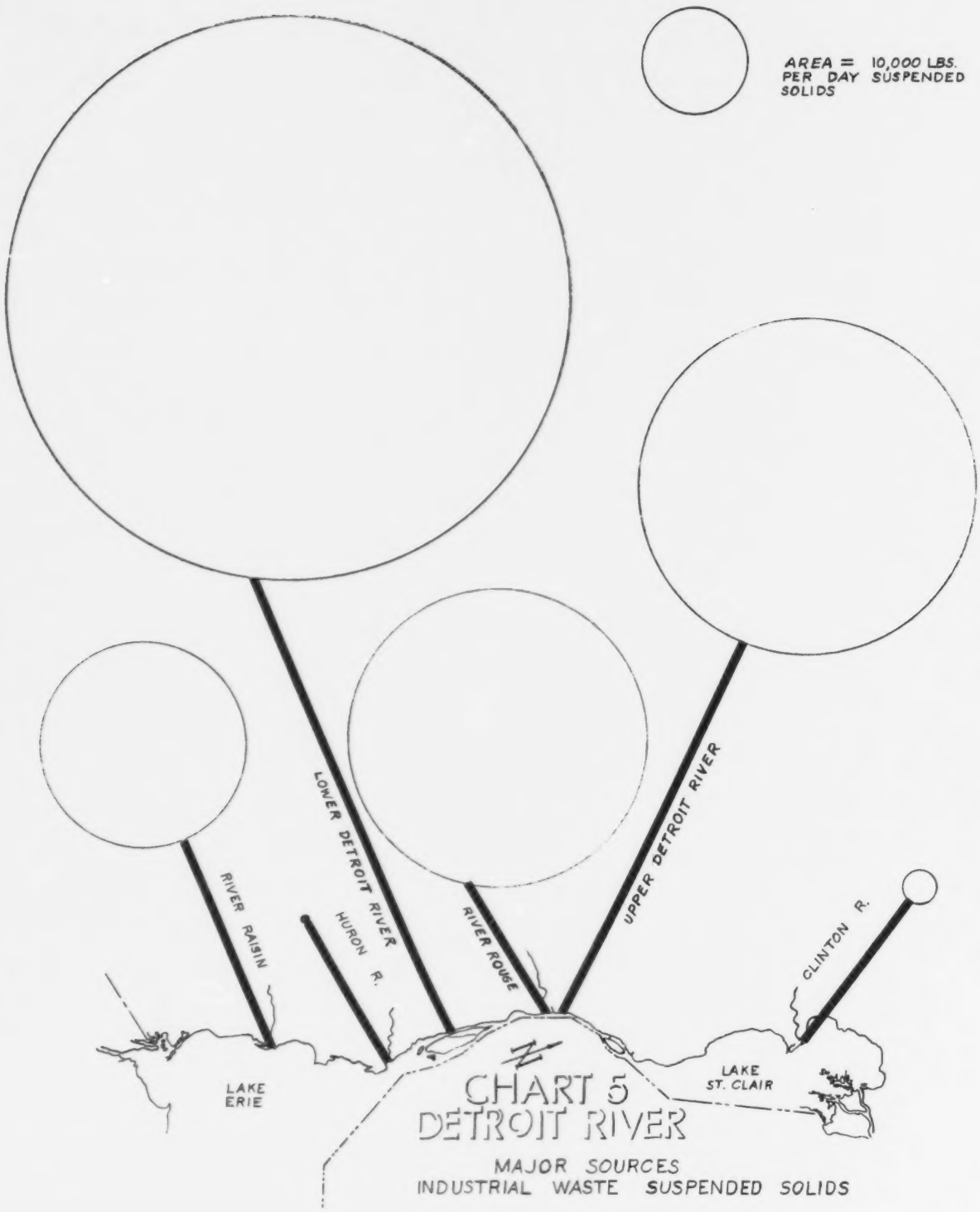


CHART 5
DETROIT RIVER

MAJOR SOURCES
INDUSTRIAL WASTE SUSPENDED SOLIDS

B.O.D.

Table 4 includes the available data on B.O.D. of industrial wastes. The total from all sources was 247,100 pounds per day, which is about 100,000 pounds per day less than the total from all sewage treatment plants.

Most of the B.O.D. from industrial sources was discharged to the River Rouge. This stream received about 200,000 pounds per day, or 81 per cent of the total in industrial wastes.

The second largest contribution was the 43,000 pounds per day, or 17.4 per cent, to the Raisin River.

The Detroit River received only 4,000 pounds per day, below the Wyandotte water plant, and the Clinton River only 100 pounds per day. There was no record of B.O.D. discharge to the Huron River.

Oil

Because of the difficulties of accurate measurement of oil, which is insoluble in water, the data on oil must be considered as approximations only, rather than as exact values.

A total of more than 7,300 pounds of oil per day was discharged to the waters of the metropolitan area. Of this more than 4,000 pounds per day, or nearly 55 per cent, entered the Rouge. The Detroit River received more than 3,200 pounds per day, or nearly 44 per cent. The upper Detroit River, above the Wyandotte water plant received 1,200 of the 3,200 pounds per day and the

lower Detroit River 1,200 pounds per day. One hundred pounds per day were discharged to the Clinton River.

The above values refer to oil that was discharged on a more or less continuous basis. These values do not reflect the oil leaks and spills that occur, and which may involve more oil and cause more damage than the more regular discharges. Records of the Water Resources Commission river patrol from June 30, 1960 through January 5 indicate at least 36 observations of oil on the river in the vicinity of, or discharging from, sewers, which were considered of sufficient importance to justify notification of those responsible. Fifteen of these oil discharges were from steel plants, 5 from municipal sewers or drains, 5 from automobile plants, 5 from coal distillization processes, 2 from brass production, and 4 from miscellaneous sources.

Phenols

Very small concentrations of phenols can cause taste in municipal water supplies, and can taint the flesh of fish.

Total phenols and phenolic compounds discharged from industries were nearly 1,200 pounds per day. Seven hundred pounds per day, or 58.7 per cent, entered the River Rouge. About 495 pounds per day were discharged to the Detroit River, with about one-half entering above the Wyandotte water plant intake and the other half below the intake.

No recent data were obtained for phenols in the effluents

of sewage treatment plants. The International Joint Commission study in 1946-1948 included analyses for phenols at the Detroit sewage treatment plant. At that time the effluent contained 438 pounds per day. Since that time the effluent discharge has increased from 350 to 580 million gallons per day. This does not necessarily indicate a proportionate, or even any, increase in phenols. If additional phenol-producing industries have been added to the collection system the total phenols in the effluent may have increased.

Ammonia

Total ammonia (as N) discharged by industry to the waters of the area was about 9,750 pounds per day.

Of this, 8,000 pounds per day, or 82 per cent reached the Detroit River below the Wyandotte water intake. One thousand pounds, or 10.2 per cent, entered the River Rouge. The remainder, 750 pounds per day, was discharged to the Detroit River above the Wyandotte intake.

No recent data on ammonia in the Detroit sewage treatment plant effluent were obtained. In 1948 the effluent contained 52,500 pounds of ammonia per day. It is probable that the ammonia has increased at least roughly in proportion to the increase in flow to about 87,000 pounds per day, or about 9 times that in the industrial wastes.

Acid

A number of plants discharge large quantities of spent acid to the Detroit River. The waste pickle liquor from several steel mills consists principally of strong sulfuric acid and ferrous iron in solution.

Data on total quantities of waste acid are lacking, but the results of a 1955 study of wastes from 1 steel mill indicate the magnitude of such discharges. The plant was discharging about 200,000 pounds per day of sulfuric acid which was accompanied by 40,000 pounds per day of ferrous iron.

Chlorides

The wastes from several plants contain large quantities of chlorides, but data on total quantities are not available.

As 1 example, a single large industrial operation was discharging 3,000,000 pounds per day of chlorides in 1954. A large portion of the chlorides were in the form of calcium chlorides, which increase the hardness of the waters receiving the wastes.

Reductions in Industrial Wastes

Substantial reductions in pollutional constituents of industrial wastes have been accomplished since the International Joint Commission study of 1946-1948. The comparison of total quantities of materials discharged directly to the American waters of the Detroit River at that time with the estimates of present quantities is revealing:

TABLE 5

Reductions in Industrial Waste Constituents
Detroit River
1946-1948 to Present

	Oil gal/day	Phenolic Compounds lb/day	Ammonia (as N) lb/day	Suspended Solids lb/day
1946-1948	16,240	4,890	11,010	1,699,200
Present	430	495	8,750	380,000
Per Cent Reduction	97.5	89.9	20.5	77.5

The reductions have ranged from about 20 per cent in ammonia, to 98 per cent in oil. Suspended solids have been reduced about 78 per cent, and phenolic compounds 90 per cent.

EFFECTS OF WASTES ON WATER QUALITY AND USES

The principal effects on water quality of Lake St. Clair, the Detroit River, and western Lake Erie which have caused concern appear to have resulted from pollution by sewage bacteria, phenols, oils, and suspended solids.

The effects of each of these waste constituents will be dealt with separately in relation to impact on water quality and uses.

The International Joint Commission, in its 1951 Report on Pollution of Boundary Waters proposed certain objectives of water quality for guidance in the control of pollution of boundary waters. The objectives will be used, where appropriate, for evaluating water quality in subsequent sections of this report.

COLIFORM BACTERIA

The International Joint Commission objective for coliform bacteria in the boundary waters is that the median MPN shall not

exceed 2,400 per 100 ml at any point after initial dilution of sewage with the receiving waters.

Coliform objectives commonly are based on arithmetic averages rather than median values. Use of the median tends to suppress the effects on the mean of densities in the higher ranges. When the higher densities occur ingestion of the water would be most hazardous to health.

The St. Clair River is not covered by this report, but is of interest as the source of water for Lake St. Clair. Samples were collected on 9 dates at 4 points across the American side of the river at Range SR 13.7 (13.7 miles above the mouth of the St. Clair River) during May 1960 through April 1961. The median MPN values for the 4 points ranged from 230 to 430 per 100 ml, with an integrated average of 300 per 100 ml. This was well below the objective of 2,400 per 100 ml.

The bacterial quality of the waters of Lake St. Clair generally was quite good, although there undoubtedly were localized areas of excessive contamination along some sections of the lake shore. The 1951 International Joint Commission report, on the basis of extensive sampling, showed no median values in excess of 1,000 per 100 ml. The higher median values were limited to the Anchor Bay area, the immediate vicinity of the mouth of the Clinton River, and along the western shore line.

Much less extensive data than those in the 1951 report are available for this report, but such data as are available

indicate that the bacteriological quality in Lake St. Clair generally has not deteriorated significantly since the earlier work.

The Ira Township water supply intake is located about 1200 feet offshore, almost directly south of Fairhaven, in the northeast area of Anchor Bay. The annual average MPN of the raw water was 434 per 100 ml for December 1960 through November 1961. The maximum monthly mean was 752 per 100 ml in November. This represents water of good bacterial quality for a source of municipal supply.

The results of studies in 1956 and 1957 indicated that the Clinton River near its mouth was highly contaminated. The median coliform MPN of the river was 43,000 per 100 ml. During flood flow a portion of the flow is diverted to a cutoff channel which enters Lake St. Clair about 2.5 mile southeast of Mt. Clemens. The same studies yielded a median MPN of 150,000 per 100 ml near the mouth of the cutoff. This high value may reflect the effect of storm water overflows from upstream sewerage systems.

These high densities of coliform organisms undoubtedly caused excessive contamination of localized areas in Lake St. Clair around the mouths of the river and the cutoff, and constituted a health hazard to anyone coming in intimate contact with the water in these areas. The effects appear largely to be dispersed before the river water penetrates very far into the lake, although there is some evidence that bacterial contamination from

Reproduced from best available copy.

the cutoff occasionally may reach the Mt. Clemens water supply. The popular Metropolitan Beach lies between the mouths of the river and the cutoff, in the vicinity of Point Huron. Median coliform densities at points along the beach front during the 1961 bathing season varied from 91 to 230 per 100 ml. The Mt. Clemens water supply intake is situated about 1 mile offshore, approximately east of the mouth of the cutoff. The annual average MPN of the raw water for December 1960 through November 1961 was 1,240 per 100 ml. There was a maximum monthly mean of 6,160 per 100 ml in April, 1961. Bacterial quality at this intake may be influenced at times by the pollution from the cutoff, and possibly from Clinton River. In December 1959, the monthly mean was 4,670 per 100 ml, and in January 1960, the mean was 5,580. Although of good bacterial quality most of the time the Mt. Clemens raw water occasionally is subject to moderate contamination.

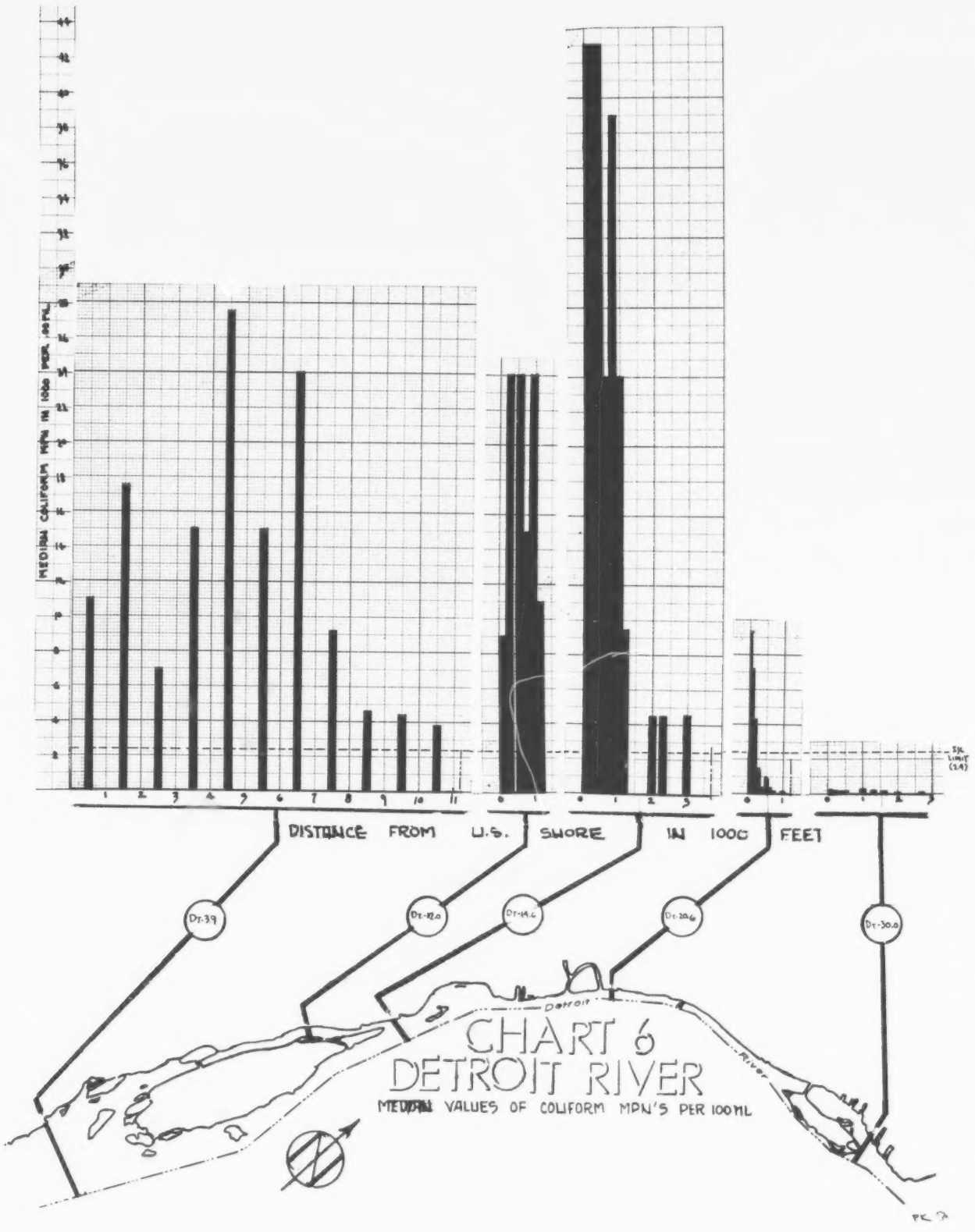
The Highland Park and Grosse Pointe Farms common water-works intake is located about 2,000 feet offshore slightly north-east of Grosse Pointe Farms. The mean bacterial quality of the raw water was not included in the operating records submitted to the Michigan Department of Health. Individual MPN values were recorded as low as 0 in every month of the period, December, 1960, through January, 1961, but maximum values were as high as 24,000 per 100 ml. The maximum month appears to have been March, 1961, when 7 values of 24,000 were reported. The higher values

occurred during months when precipitation normally is high. This suggests that the water at this intake may have been affected by storm water overflows from combined sewers along the waterfront.

The excellent bacterial quality of the water leaving Lake St. Clair is reflected in the results of sampling at 10 points across the American section of the river on Range Dt. 30.0, near the head of the Detroit River. Here the median densities for 9 sampling dates during 1960 ranged from 48 to 240 per 100 ml. The mean for all points was 107 per 100 ml. (Chart 6).

The low bacterial density at Range Dt 30.0 was confirmed by the excellent bacterial quality of the raw water of the Detroit supply, which is drawn from the river at the upper end of Belle Isle, about three-quarters of a mile below Range Dt. 30.0. The annual average MPN of this supply during 1961 was 55 per 100 ml.

About 8.5 miles downstream, and about 1 mile above the Detroit Sewage Treatment Plant and River Rouge, at Range Dt.20.6, deterioration of the bacterial quality of the Detroit River became apparent. At 11 points on this range median densities from 7 sampling dates varied between 930 and 9,300 per 100 ml. The median values at 2 of the 11 points equalled the objective of 2,400 per 100 ml., and at 4 points exceeded the objective. The higher values were within 500 feet of the shore. The integrated mean for all points was 1,800 per 100 ml. Two of 77 values on individual samples taken on this range were 43,000 per 100 ml,


MEDIAN COLIFORM MPN IN 100 PER 100 ML
DISTANCE FROM U.S. SHORE IN 1000 FEET
Dt-3.9
Dt-11.0
Dt-19.6
Dt-20.6
Dt-30.0
DETROIT
River
CHART 6
DETROIT RIVER
MEDIAN VALUES OF COLIFORM MPN'S PER 100 ML

2 were 73,000, 4 were 93,000, and 3 were 240,000. This illustrates how use of the median minimizes the significance of the higher and more hazardous values, which probably resulted from storm water overflows from the high concentration of overflow points immediately upstream.

At Range Dt. 14.6, about 5 miles below the Detroit Sewage Treatment Plant and River Rouge, 13 points across the river were sampled. The Wyandotte water plant intake is just below this range. Median MPN values at the 13 points ranged from 4,300 to 43,000 per 100 ml. Five points, between 20 and 400 feet offshore yield medians of 43,000 per 100 ml. Three points between 2,000 and 3,000 feet offshore yielded medians of 4,300 per 100 ml. Values between these 2 extremes were found at points between 600 and 1,100 feet offshore. Thus every median was between 1.8 to 18 times the coliform objective. The integrated mean for all points was 13,200 per 100 ml. This was about 44 per cent higher than the integrated value of 9,200 per 100 ml for the 1946-1948 study.

Monthly average MPN values of the Wyandotte raw water for 1961 are shown on (Chart 7). The annual average of the monthly values was 21,700 per 100 ml. In 2 months, June and September, the average MPN's were 50,000 per 100 ml. Chart 7 includes the monthly average values for the Detroit raw water, which averaged 55 during 1961. Here maximum average MPN for any month was 260 per 100 ml in March.

Chart 8 presents a comparison of median coliform values of the Wyandotte raw water from August 1950, when the present intake was placed in operation, through December 1952, and from August 1959 through December 1961. The median MPN for the earlier period was 6,400 per 100 ml, and nearly double that, or 12,200 per 100 ml for the later period.

Charts 7 and 8 illustrate the differences that result from the use of median and average values. The use of the 2 systems in this report stems from the different statistical methods used by the various agencies from which data were obtained. It was not feasible, in the time allotted for preparation of this report, to process the masses of daily data available to obtain means by a single method. Where comparisons are made with the International Joint Commission median objective the average values used are medians.

The raw water source for the Wyandotte municipal supply is grossly contaminated by sewage bacteria. The major sources of the bacteria are the Detroit Sewage Treatment Plant effluent, and the highly contaminated River Rouge, which enter the river about 5 miles upstream from the Wyandotte intake, and storm water overflows. The bacteria from the treatment plant and the River Rouge, and other pollution accompanying them, reach the water intake in about 4 hours after they enter the river. Under the circumstances constant vigilance and special precautions in operation of the Wyandotte treatment processes are essential to

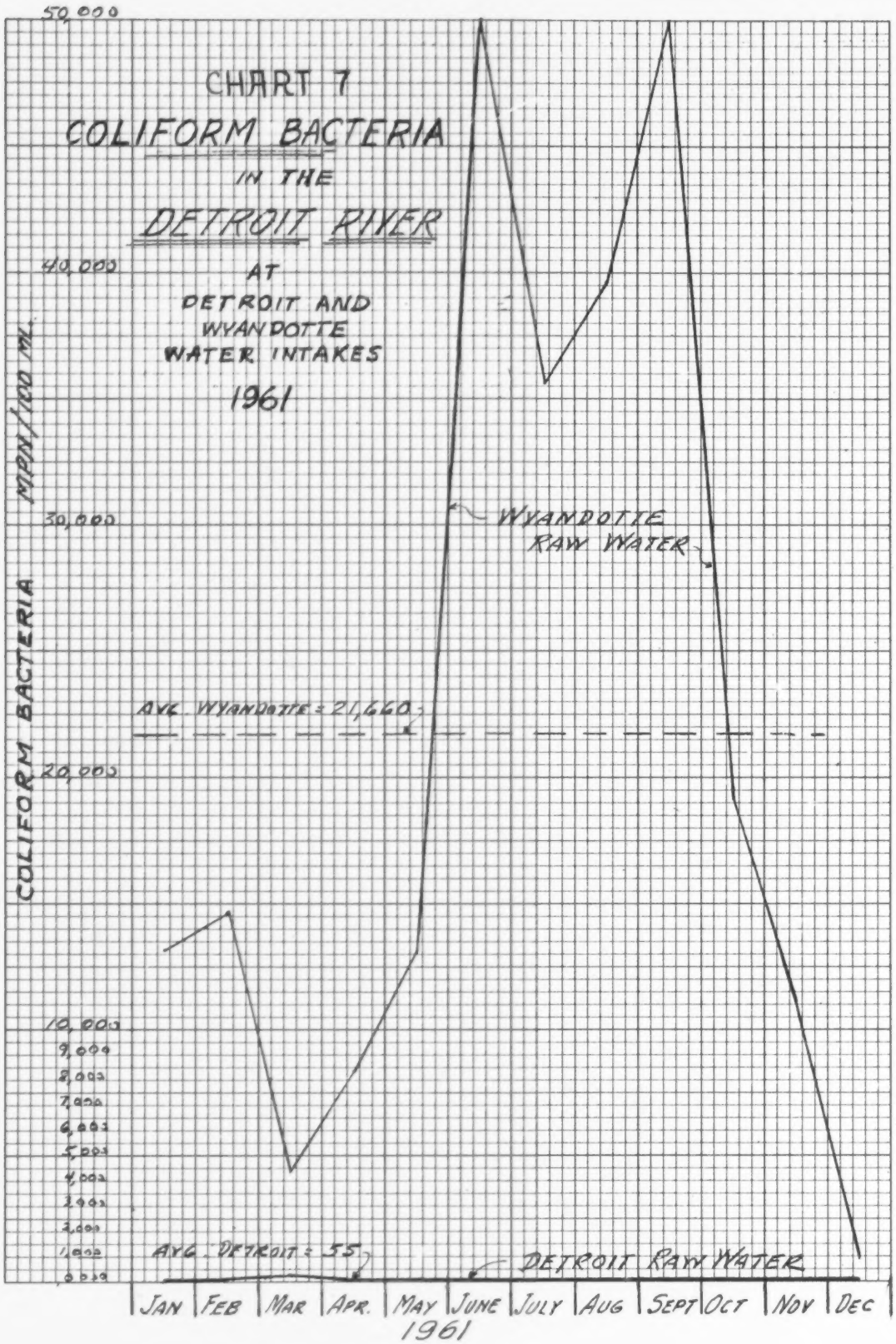


CHART 7
COLIFORM BACTERIA
IN THE
DETROIT RIVER
AT
DETROIT AND
WYANDOTTE
WATER INTAKES
1961
COLIFORM BACTERIA MPN/100 ML.
50,000
40,000
30,000
20,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
WYANDOTTE
RAW WATER
AVG. WYANDOTTE = 21,660
AVG. DETROIT = 55
DETROIT RAW WATER
JAN
FEB
MAR
APR.
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1961

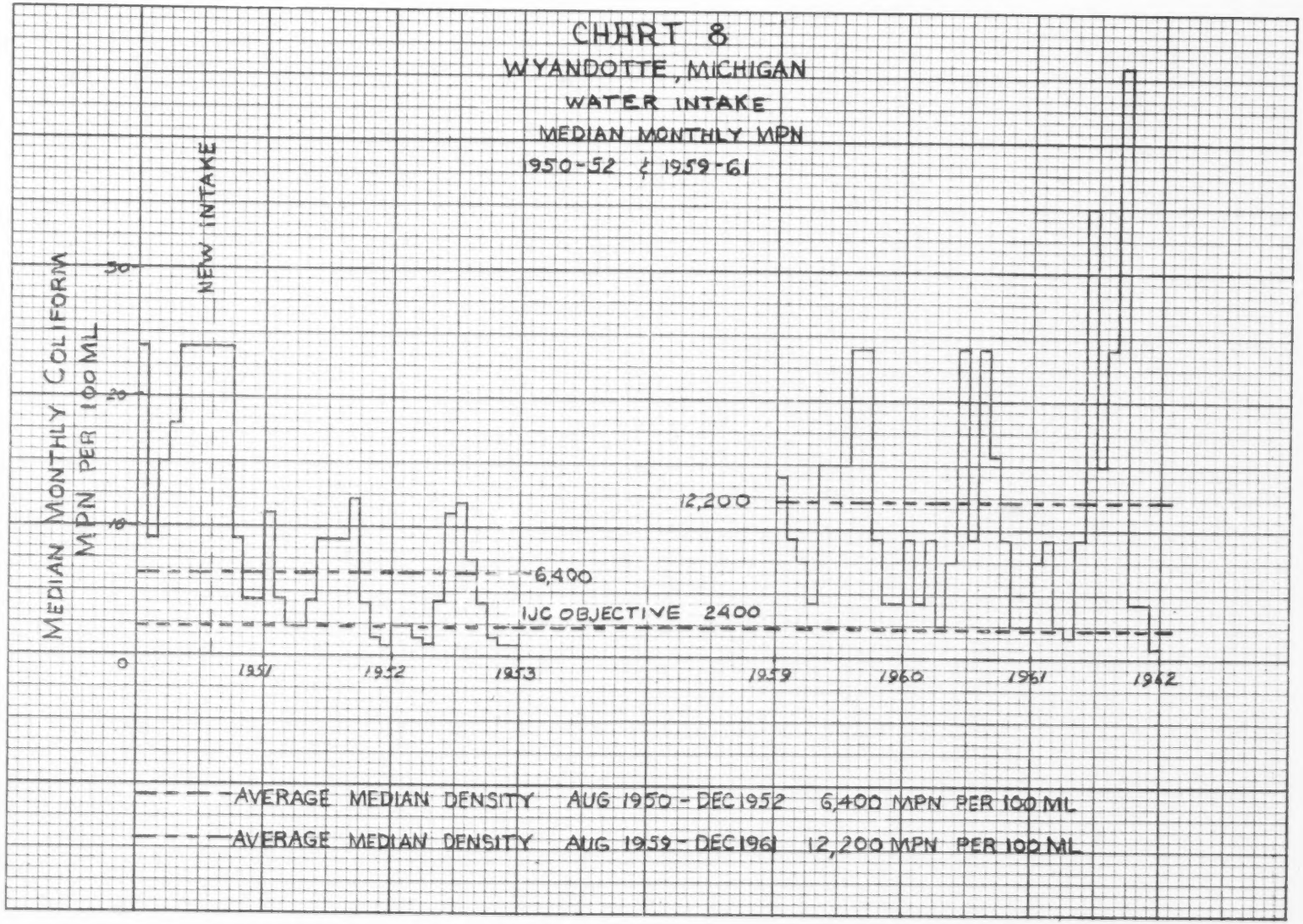


CHART 8
WYANDOTTE, MICHIGAN
WATER INTAKE
MEDIAN MONTHLY MPN
1950-52 & 1959-61
MEDIAN MONTHLY COLIFORM MPN PER 100 ML
NEW INTAKE
30
20
10
0
6,400
12,200
IJC OBJECTIVE 2400
1951
1952
1953
1959
1960
1961
1962
AVERAGE MEDIAN DENSITY AUG 1950 - DEC 1952 6,400 MPN PER 100 ML
AVERAGE MEDIAN DENSITY AUG 1959 - DEC 1961 12,200 MPN PER 100 ML

52-B

assure production of a bacteriologically safe and potable water at all times. The residual of chlorine that is applied to the raw water is monitored constantly by automatic equipment which sounds an alarm if the chlorine residual drops below the necessary concentration. When this occurs the chlorine dosage is increased manually to meet the increased chlorine demand. There is the ever present possibility of a mechanical or electrical failure, or of a human error in adjusting treatment processes to meet the fluctuating quality of the raw water. Such failure or error could permit water contaminated with sewage bacteria to pass through the treatment plant and enter the distribution system. Should this occur an epidemic of water-borne disease among consumers of the water probably would follow.

Trenton formerly maintained its own water supply system, which drew water from the Trenton Channel several miles below Wyandotte. The treatment plant serving this system was abandoned in the early 1940's when expansion of the plant to provide additional capacity became necessary. The excessive pollution of the raw water source played a part in this decision. Water is now obtained from the Wayne County Metropolitan Water Supply.

On Range 12.0 in the Trenton Channel, 2.4 miles below the Wyandotte water intake, 6 points were sampled. This range is below the Wyandotte sewage treatment plant. The median values varied between 9,300 and 24,000 per 100 ml, including medians of 24,000 at 3 of the 6 points. The medians were 3.9 to 10

times the objective. The integrated mean for the range was 20,500 per 100 ml. This was 25 per cent higher than the integrated mean of 16,400 per 100 ml from the 1946-1948 study.

Recent sampling at the farthest downstream range, Dt. 3.9, has been limited, with samples collected on only 6 sampling dates from each of the 11 points on this range during March to July, 1961. The data for this range, therefore, are less meaningful than those for ranges 14.6 and 12.0, which were sampled 44 and 39 times respectively. The medians of these data range from 4,400 to 19,500 per 100 ml. The integrated mean for the range was 12,700, compared to 21,800 per 100 ml from the 1946-1948 study. This indicates a reduction in bacterial contamination of more than 40 per cent during the intervening years, but no such reduction is supported by the more abundant data for ranges 14.6 and 12.0, where increased contamination was indicated.

The Monroe water plant intake is situated about 1 mile southeast of Point Aux Peaux in the western end of Lake Erie. The annual average MPN of the raw water was 792 per 100 ml from December 1960 through November 1961. The maximum monthly average was 2,120 in October 1961. During December 1960 through November 1961, 7 daily MPN values were as high as 11,000 to 14,000 per 100 ml, but no other daily value exceeded 4,600 per 100 ml. During the past 2 years the highest monthly average was 3,730 per 100 ml in July 1960. The bacterial quality of the raw water at the Monroe intake generally is satisfactory as a

source of municipal supply.

Sterling State Park Beach fronts on Brest Bay, about 5 miles southwest of the Monroe water intake. The beach lies between 1 and 2 miles north of the mouth of the Raisin River, which flows through Monroe. Starting near the northern end of the beach and extending around Brest Bay for about 4 miles to Stony Point, homes line the waterfront. These homes are in areas which do not have municipal sewerage systems. Disposal of sewage in these areas is either directly to the nearest water, including Brest Bay, or to individual underground disposal systems. High ground water levels and tight soils cause many of the underground disposal systems to fail. Such failure permits the sewage to flow to the nearest watercourse. Sandy Creek enters Brest Bay near the northern end of Sterling State Park Beach. Stony Creek enters the bay about halfway between Sandy Creek and Stony Point. Both of these creeks pass through unsewered communities.

In 1956 the Michigan Water Resources Commission collected samples for coliform bacteria determinations from 6 points short distances offshore along Sterling State Park Beach. The MPN results of 15 to 20 samples at each point varied widely. At the northern end of the beach the densities of coliform bacteria varied between 9.1 and 24,000 per 100 ml, with 3 values above 2,400 per 100 ml. At the southern end of the beach the densities ranged from 93 to 140,000 or more per 100 ml, with 4 values above 2,400 per 100 ml. The bacterial densities varied similarly at the

4 intermediate sampling points, with the lowest contamination occurring near the middle of the beach. Of 100 samples collected 23, or nearly one-quarter, yielded MPN values in excess of 2,400 per 100 ml. In 1957 sampling was extended to include possible sources of bacterial contamination in the surrounding area. The largest single source of coliform bacteria was 1 of the 5 pulp and paper mills in Monroe. The effluent from this plant had a median density of 43,000,000 coliform bacteria per 100 ml, for a total daily discharge of 13,000,000 billion coliform bacteria per day. It was established that at least some of the coliform bacteria were of fecal origin. Another large contributor, based on the estimate in Table 2, was the Monroe County shore front homes, with a total estimated contribution of 184,000 billion per day. The Monroe sewage treatment plant, with chlorination of the effluent, accounted for 3,100 billion. The Raisin River at its mouth reflected the high coliform load primarily from the pulp and paper mill, with a median density of 330,000 per 100 ml. Sandy Creek had a median density of 4,300 per 100 ml and Stony Creek had 9,300 per 100 ml.

Subsequently, acting upon the advice of the Michigan Department of Health, the Michigan Department of Conservation posted Sterling State Park Beach as unsafe for swimming. Attendance at the park had been as high as 1,239,000 in a season. After the beach was closed attendance at the park dwindled. State funds in excess of $1,000,000 previously had been spent on the park.

Additional expenditures for further development of the park have been postponed. The publicity attendant on this situation has caused concern among owners of nearby shore front homes, who now question the quality of water along their private beaches.

Bacteriological data throughout all of the watercourses indicate that contamination generally is greatest close to the shore. In areas where bacterial densities are high those launching boats from shore must pass through the zone of greatest contamination before reaching the less contaminated water farther from shore. Children and others playing, wading, or swimming near the water's edge likewise are exposed to high concentrations of contamination.

Chart 9 illustrates the bacterial quality along the Detroit water front, from the head of the Detroit River to about 1 mile below the mouth of the River Rouge. These data were obtained by the City of Detroit Health Department. Above Belle Isle the coliform densities were relatively low, with MPN medians of less than 1,000 per 100 ml. Near the upper end of Belle Isle the density increased to about 4,400 per 100 ml, which is above the objective of 2,400 per 100 ml. From this point downstream the contamination increased markedly, with all medians at the 7 remaining points greater than 40,000 per 100 ml throughout the rest of the reach. The maximum value at any sampling point was 158,000 per 100 ml at the foot of Joseph Campau Avenue. Anyone ingesting a single drop of water with this bacterial density would swallow about

80 sewage bacteria. At an MPN of 40,000 per 100 ml each drop of water would contain about 20 coliform bacteria. Under the circumstances the City Health Department has been wise in prohibiting swimming along the Detroit waterfront.

The International Joint Commission Field Unit made a special study of the effects of storm water overflow on bacterial quality at Range 20.6, about 1 mile above the Detroit Sewage Treatment Plant and below the numerous sewer overflows along the Detroit waterfront. This range was sampled at 10 points both during dry weather and following 3 storms when sewage overflows to the river occurred. The median coliform results are shown on (Chart 10).

During dry weather only 1 of the 10 mean densities exceeded 2,400 per 100 ml. This mean MPN was 2,510 per 100 ml. The mean for all sampling points was 1,230 per 100 ml. The effects of the storm water overflows extended about 500 feet offshore at this range. Near the shore the average MPN rose to 73,000 per 100 ml. At 4 other points densities increased to: 21,000; 24,000; 32,000; and 43,000 per 100 ml. At 500 feet from shore the increase was from 320 during dry weather to 4,800 following the storms. The mean for all points following the storms was 20,100 per 100 ml, or more than 16 times the dry weather mean. This demonstrates dramatically the problem that will remain, despite improved efficiencies of sewage treatment, so long as combined sewers pour raw sewage into the river from sewer overflows.

CHART 9
DETROIT RIVER

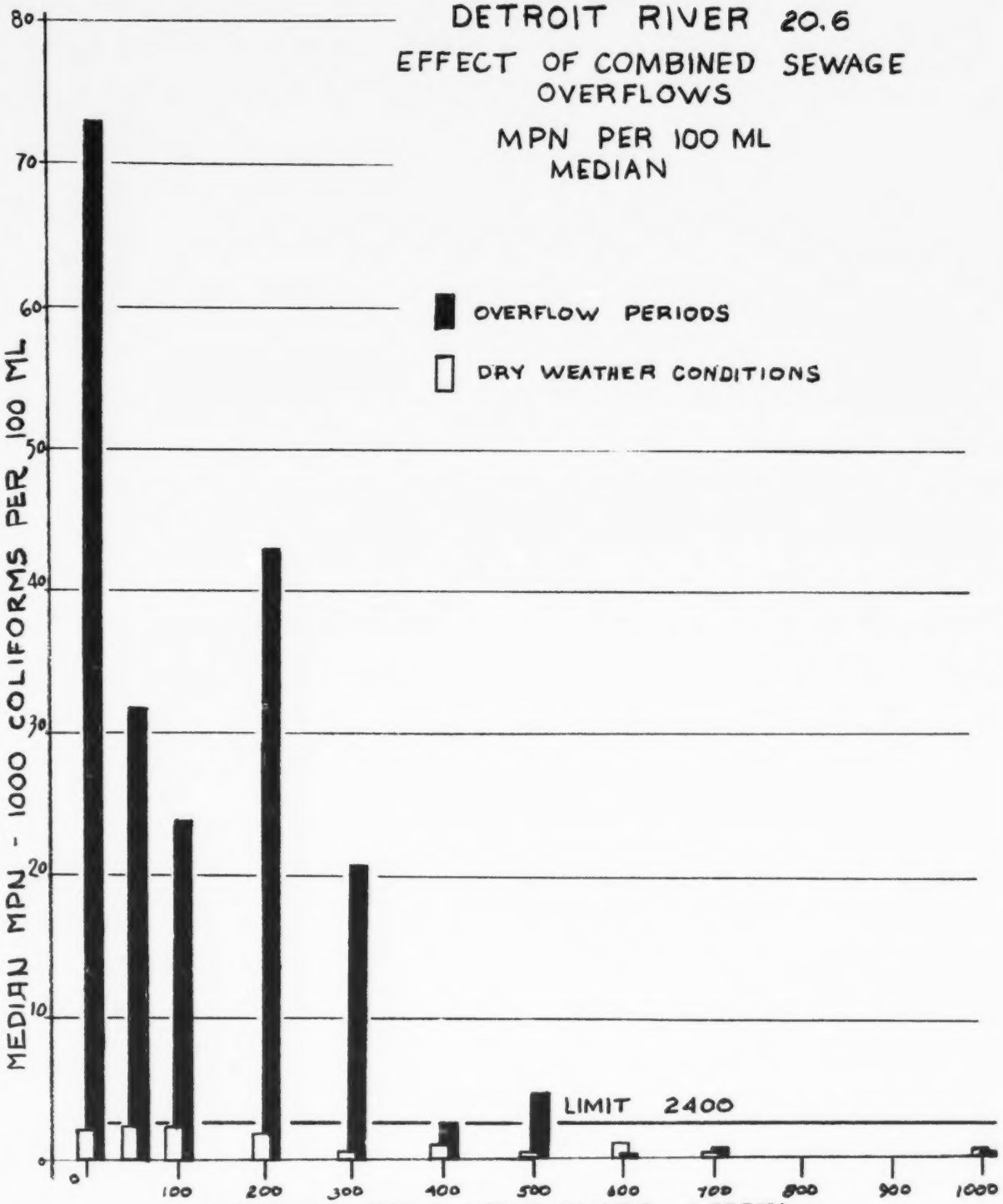
MEDIAN COLIFORM MPN PER 100 ML. - 1961
DETROIT WATERFRONT

CHART 10

DETROIT RIVER 20.6

EFFECT OF COMBINED SEWAGE OVERFLOWS

MPN PER 100 ML
MEDIAN



1960 - 1961 SURVEYS
MICHIGAN WATER RESOURCES COMMISSION

The following conclusions are limited to factors directly or indirectly affecting the American waters of Lake St. Clair, the Detroit River, and the western end of Lake Erie. They do not include possible local pollution of tributary streams.

Although commendable progress has been made in sewage treatment since 1946-1948, further improvements are needed to minimize the hazards of excessive bacterial contamination. The more serious problems indicated by available data are the high densities of sewage bacteria throughout much of the Detroit River below Belle Isle which constitute a hazard to recreational uses, the excessive coliform content of the Wyandotte source of water supply, and the unsatisfactory bacterial quality of water at the Sterling State Park Beach. Major needs for improvement include elimination from the River Rouge of the unchlorinated Dearborn sewage discharge, more effective disinfection of the Detroit sewage plant effluent, provisions of sewerage systems with adequate treatment facilities for lake shore homes, especially in the Monroe area, and measures for reducing the effects of discharges of raw sewage from storm water overflows throughout the metropolitan area.

Additional investigation is needed to clarify other apparent problems. These include identification of the source or sources of occasional high coliform densities of the Mt. Clemens raw water and possibly of the Highland Park and Grosse Pointe Farms raw water, and evaluation of the effect of untreated sewage

from shore front homes, identification of the sources of bacterial contamination of the water along Sterling State Park Beach, and accurate determination of densities of coliform bacteria in the Detroit Sewage Treatment Plant effluent.

PHENOLIC COMPOUNDS

There has been significant reduction in the problem of taste in municipal water supplies because of excessive phenolic pollution of sources of raw water, which caused concern at the time of the 1947-1948 study. Those responsible for the Detroit and Wyandotte municipal supplies report that there have been no occasions in recent years when phenolic content of the raw waters exceeded the capacities of their treatment facilities to prevent medicinal tastes in the water supplied to consumers. Occasional phenolic tastes still are detected in chlorinated raw waters, and Wyandotte uses special treatment methods to control the tastes. Data on phenols in Lake St. Clair and Lake Erie were not obtained for this report, and the operators of plants on these lakes were not interviewed on this subject.

Data for the Detroit River are somewhat conflicting, but indicate that phenolic materials still exceed the International Joint Commission objective.

The objective states that the concentration of phenol or phenol equivalents should not exceed an average of 2 parts per billion (p.p.b.) and a maximum of 5 p.p.b. after initial dilution of the wastes.

Data on average phenol concentrations at selected ranges in the Detroit River are presented on (Chart 11).

At Range SR 13.7, on the St. Clair River, the average phenol concentration at no point in American waters exceeded the average objective of 2 p.p.b. At 1 point a maximum value of 7 p.p.b. exceeded the maximum objective of 5 p.p.b.

On Range Dt. 30.0, near the head of the Detroit River and just above the Detroit water plant intake, the over-all average of average values was 1 p.p.b. One maximum value of 6 p.p.b. slightly exceeded the maximum objective. The over-all average of maximum values was 3 p.p.b. In 1946-1948 the average was 3.8 p.p.b., and the average of maximum values was 15.6 p.p.b. Reduction of phenols at this range since 1946-1948 has been about 75 per cent.

Range 20.6 is above the point of discharge of the Detroit Sewage Treatment Plant and the River Rouge. The recent average phenol concentration exceeded the average objective at only 1 of 8 sampling points, with an over-all average of 1.8 p.p.b. The 1946-1948 average was 2.9 p.p.b. The recent average of maximum values was 6.8 p.p.b., compared to 31.4 p.p.b. in 1946-1948. A slight reduction in average values and a marked reduction in maximum values has occurred since the earlier period.

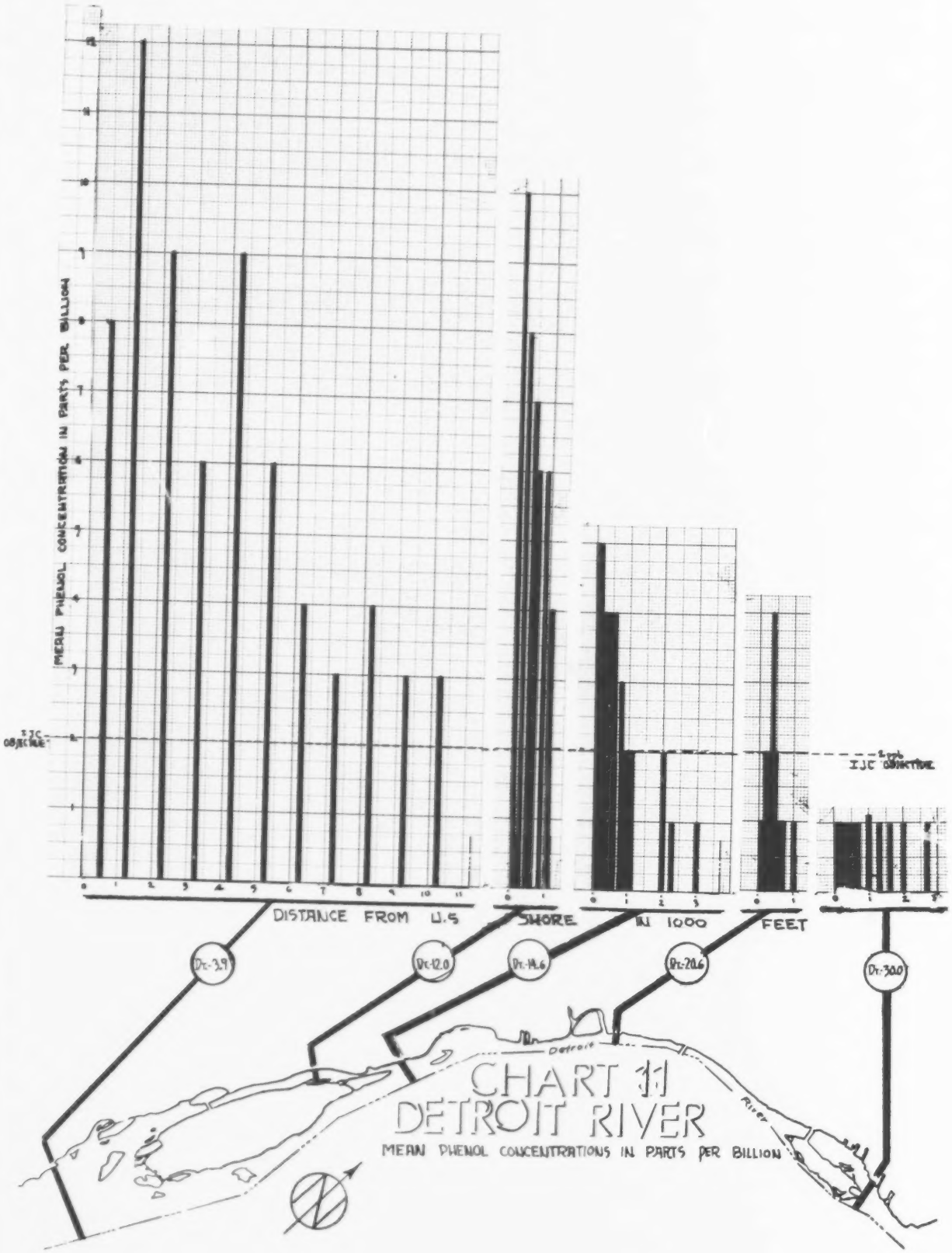
The Wyandotte water plant intake is just below Range Dt. 14.6. Here the recent average phenols were 3.1 p.p.b., compared to 6.8 p.p.b. in 1946-1948. The recent average of maximum values was 16.8 p.p.b., compared to 16.0 in 1946-1948. The reduction in

average values has been more than 50 per cent, but the data indicate no improvement in maximum values, which represent the effects of slugs of phenolic substances. The improvement in taste of the Wyandotte treated water apparently reflects improved treatment methods rather than a marked reduction in phenol content of the raw water.

At Range 12.0, in Trenton Channel, recent average concentrations have been 6.5 p.p.b., compared to 15.6 in 1946-1948. The average of maximum values was 28.5 p.p.b., which represents a marked reduction from the 93.2 p.p.b. of 1946-1948.

The recent average at Range 3.9, near the mouth of the Detroit River, has been 5.2 p.p.b., which is only slightly less than the 7.3 p.p.b. average of 1946-1948. The 19.1 p.p.b. average of maximum values is slightly greater than that of 16.4 p.p.b. in 1946-1948. Sampling on this range was limited in both periods, and the data may not be adequate for valid comparison.

Consideration of all phenol data indicates that there has been a reduction in phenolic substances in the waters above the Detroit water plant intake, and above the Detroit Sewage Treatment plant and Rouge River since 1946-1948. The evidence at ranges below this point is conflicting. At the Wyandotte water plant intake reduction in average phenols, but not in maximum values, is indicated. In the Trenton Channel the data indicate reductions in both average and maximum values. Near the mouth of the river the limited data available indicate little, if any, change in either average or maximum values since 1946-1948.


MEAN PHENOL CONCENTRATION IN PARTS PER BILLION
IJC OBJECTIVE
DISTANCE FROM U.S SHORE
IN 1000 FEET
IJC OBJECTIVE
Pt.-3.9
Pt.-12.0
Pt.-19.6
Pt.-20.6
Pt.-30.0
Detroit
River
CHART 11
DETROIT RIVER
MEAN PHENOL CONCENTRATIONS IN PARTS PER BILLION

The water quality at the Detroit intake very nearly meets the phenol objectives and above the Detroit Sewage Treatment Plant and River Rouge exceeds the objectives only slightly. At the range just above the Wyandotte water intake the average objective is exceeded by about 50 per cent, while the average of maximum values is a little more than 3 times the objective. In the Trenton channel the average is more than 3 times the objective and the average of maximum values nearly 6 times the objective. Near the mouth of the river the average is more than twice the objective and the maximum nearly 4 times the objective.

Despite the excess of phenolic substances over the objectives, they appear to have caused no taste problem in the Wyandotte treated water in recent years. Special water treatment methods, however, are necessary for prevention of medicinal tastes. The methods include use of chlorine dioxide.

No reports have been received of phenolic tastes in the flesh of fish taken from the Detroit River.

OIL

It is impractical to measure oil in large streams, and no quantitative data on oil in the waters of the Detroit area are available. Evaluation of the oil pollution problem can be based only on reports of visual observations, and on reported evidences of the effects of pollution.

Previously in this report it was noted that the Water

Resources Commission river patrol reported evidence of significant oil leaks or spills to the Detroit River on 36 occasions between June 30, 1960 and January 5, 1962. Fifteen of these originated in steel plants and 15 others were evenly distributed among municipal sewers, automobile plants, and coal distillation process plants.

One dramatic effect of oil pollution is its effects on ducks. Oil can cause the death of ducks in several ways. The oil coats their feathers and they become waterlogged, lose their ability to fly, and may drown. Oil also breaks down the feathers' insulating capacity, and the ducks may freeze to death. Ducks covered with oil do not eat normally and may starve to death. The ducks attempt to preen oil off their feathers, and may ingest toxic materials that cause their death.

There have been a number of duck kills over the years that were attributed to oil pollution. Forty-four per cent of all dead ducks collected between 1948 and 1955 had oil on their feathers. The oils found on the ducks were of the ordinary refined, lubricating types, indicative of industrial sources. Data are not available on total numbers of ducks killed by oil pollution during 1948 to 1955, but it is indicated that oil has been a significant factor in duck mortality during that period.

From 1956 through 1959 duck mortalities were small. In March 1960, however, an estimated 12,000 ducks died in the lower Detroit River. Infrared spectroscopic analyses of oil from the

feathers of dead ducks indicated that the oil was a glyceride type found in both municipal sewage and certain industrial wastes. At that time raw sewage was being bypassed to the Detroit River and tributary streams from several sources. The City of Detroit was diverting about 80 mgd from the Northwest interceptor to the River Rouge while a section of this interceptor was being rebuilt. For a similar reason the Wayne County Road Commission was bypassing about 4 mgd to Ecorse River. There were combined sewer overflows from Oakwood, Miller Road, the Dearborn West Side, and the Wyandotte pumping station. Although the evidence was only circumstantial, representatives of the Water Resources Commission concluded that sewage was the most likely source of the oil and grease.

Oil pollution contributes to the fouling of boats, necessitating laborious cleaning and repainting. On at least 1 occasion in the last few years an industrial oil spill resulted in the fouling of a large number of boats which are reported to have been cleaned and repainted at company expense.

Oil tends to accumulate in eddies along the river bank, and on becoming mixed with other floating debris presents a most unpleasant appearance which destroys the aesthetic appeal of the water. Such pockets of oily scum are evident from time to time at various points along the Detroit waterfront. Sections of the banks of the River Rouge are coated with black oil deposits for several feet above normal water level, and oil floats on the surface of this river in some areas.

Although good progress has been made in the control of oil pollution further reduction in this type of pollution is needed. Greater precautions against oil spills and leaks in industrial plants is an especial need.

SUSPENDED SOLIDS

No data on suspended solids in the area's waters were obtained for this report. The effects of the solids may be apparent as discoloration of the watercourse for various distances below the points of discharge. The effects also may be reflected in the types and numbers of aquatic organisms found on the bottom of the receiving waters.

An industrial plant on the Trenton Channel is faced with a difficult solids control problem. Finely dispersed iron particles in the wastes discolor a section of the Detroit River for many miles downstream, and are reported to have persisted into Lake Erie before being dissipated. There have been complaints by downstream boat owners that the solids settle close to shore and make it difficult or even impossible to launch boats through the resulting deposits. The company has attempted several treatment methods at considerable expense, but has not achieved a solution to the problem.

Available biological data indicate that organic suspended solids have settled to the bottom of the lower Detroit River and seriously altered the species of bottom organisms on which fish feed. Chart 12 illustrates the results of a bottom organism

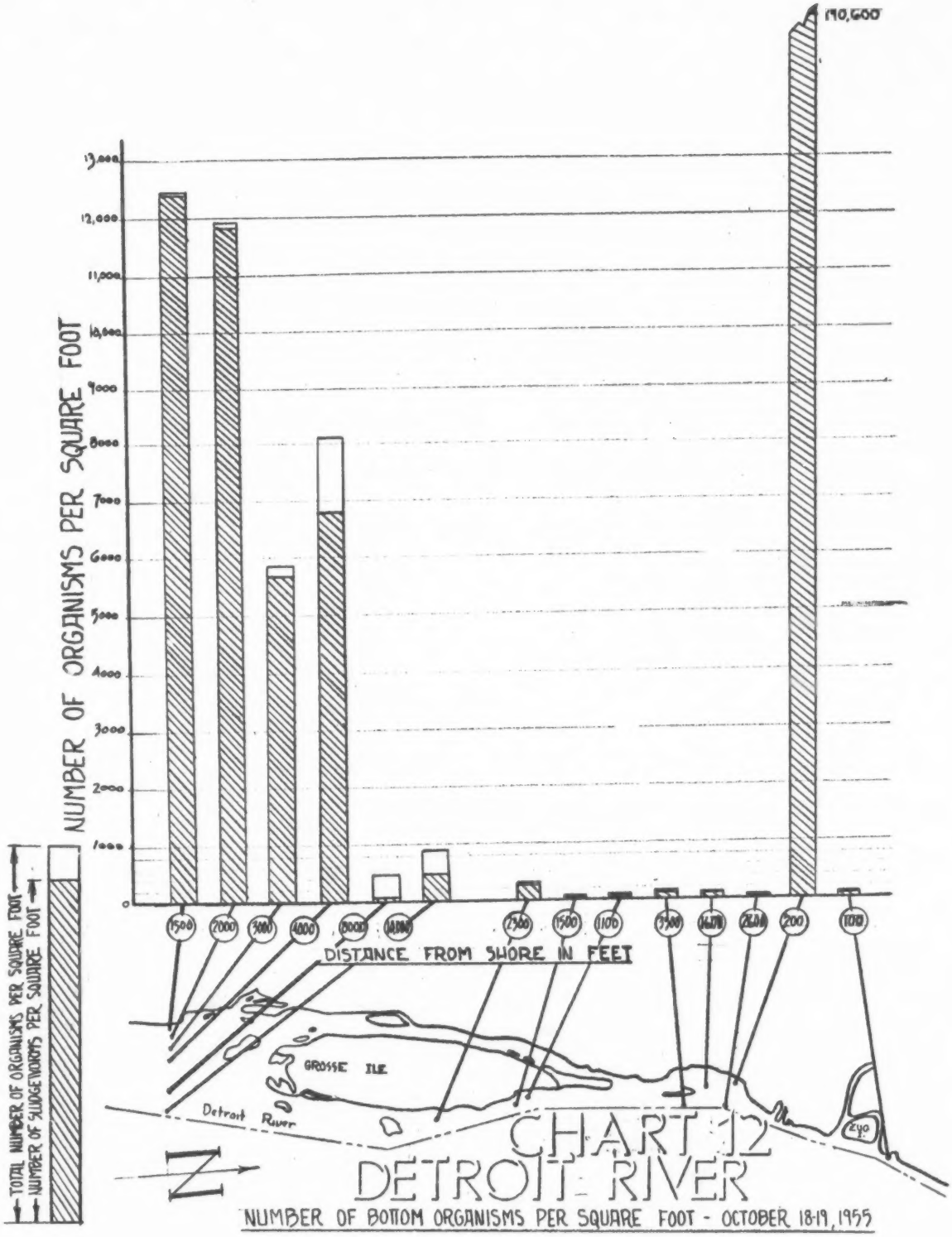


CHART 12
DETROIT RIVER

NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT - OCTOBER 18-19, 1955

survey by a biologist of the Water Resources Commission. The survey extended from Range Dt. 20.6, above the Detroit Sewage Treatment Plant and the River Rouge, downstream to Range Dt. 3.9.

Total bottom organisms were relatively low in and near the channel from Range Dt. 20.6 downstream to a point east of the middle of Grosse Ile. The total numbers in this reach were about 100 or less per square foot, with 1 exception. Near the shore a short distance above Ecorse River a mass of sludge worms, numbering 190,600 per square foot, was found. These worms, indicated by the dark portions of the bars on (Chart 12), typically are found living on sludge deposits formed by the settling of organic suspended solids. Dense populations of the worms invariably are associated with pollution of stream bottoms by organic matter. It is noteworthy that at least a portion of bottom life at all points consisted of these worms. At Range Dt.3.9, where water velocities are lower and suspended solids settle more readily, the worm populations generally were high. Two counts of several hundred bottom organisms were found at distances of 8,000 and 10,000 feet from shore. Significant portions of the aquatic organisms at these 2 points were species other than sludge worms. At the 4 sampling points within 4,000 feet of shore, however, the sludge worm counts were in the thousands, varying from a little less than 6,000 to more than 12,000 per square foot and other species represented only minor portions of the total counts. The presence of quantities of organic sludge is evidenced by the preponderence

of sludge worms at the 4 inshore sampling points.

All of the primary sewage treatment plants discharging to the Detroit River, the Dearborn plant discharging to the River Rouge, and storm water overflows, contribute to the sludge deposits in the lower Detroit River. Industrial wastes discharged to the Detroit River and to the River Rouge account for approximately as much suspended solids as do the sewage treatment plant effluents. These suspended solids also contribute to the sludge deposits.

Further investigation of the sludge deposits are needed. If the investigation reveals that the sludge deposits are as abundant as is indicated by the sludge worms, the sewage and industrial sources of the deposits should be identified more specifically. Identification of the industrial sources of organic solids especially is needed, because of the lack of recent data in some cases, and because suspended solids from a number of industrial plants are inorganic rather than organic.

B. O. D.

B.O.D. has been used as one means of characterizing sewage and industrial wastes in the section on sources of wastes in this report. It is not, however, considered as a significant factor in evaluating effects on water quality and uses in Lake St. Clair, the Detroit River, and western Lake Erie. There is no evidence that B.O.D. of any of the wastes causes significant oxygen depletion of these waters.

There is serious local oxygen depletion in some of the tributary streams, notably the River Rouge and the Clinton River. In the former, especially, total depletion of oxygen occurs for many weeks each summer. Evaluation of the conditions of the tributaries, except as they may influence the principal waters under consideration, is not within the province of this report.

AMMONIA

Only 1 effect of ammonia on water use is evident in the data obtained for this report.

The Wyandotte water treatment plant employs chlorination to a free residual as 1 important measure of protection against the excessive bacterial contamination of the raw water. Any ammonia present in water must be converted to nitrogen trichloride or oxidized to free nitrogen by chlorine before a free chlorine residual can be obtained. As concentrations of ammonia increase, corresponding larger dosages of chlorine must be applied to assure attainment of the desired free chlorine residual.

The effect of ammonia on chlorine used at the Wyandotte plant is apparent in a comparison of the chlorine dosages employed at the Detroit and Wyandotte water treatment plants. Chart 13 shows monthly average chlorine dosages and residuals for both plants in 1961. The dark area on the chart for each plant represents the difference between chlorine dosage and residual. This difference is the chlorine consumed.

The Detroit plant used an average chlorine dosage of 1.28 milligrams per liter (mg/l), to obtain an average residual of 0.46 mg/l in 1961. The average chlorine consumed was 0.82 mg/l. The Wyandotte plant applied an average dosage of 2.64 mg/l to obtain an average residual of 0.94 mg/l. The average chlorine consumed was 1.70 mg/l, or a little over twice the chlorine consumed by the Detroit raw water. Also, the chlorine residual maintained at the Wyandotte plant to control bacterial contamination and tastes was double the residual maintained at the Detroit plant.

Possibly constituents other than ammonia contribute in a minor degree to the chlorine consumption of the Wyandotte raw water, but ammonia undoubtedly is a factor. Available evidence indicates that the ammonia is principally from the Detroit Sewage Treatment Plant effluent and from natural sources, with minor quantities from industrial plants discharging wastes to the River Rouge and the Detroit River above Wyandotte.

MISCELLANEOUS FACTORS

Several other possible causes of pollution of the Detroit River have been examined. All indicate some effects of sewage and wastes discharged in the Detroit area.

Carbon Filter Chloroform Extractables

Carbon filters have been operated on the raw waters at the Detroit and Wyandotte water plants for several years. The

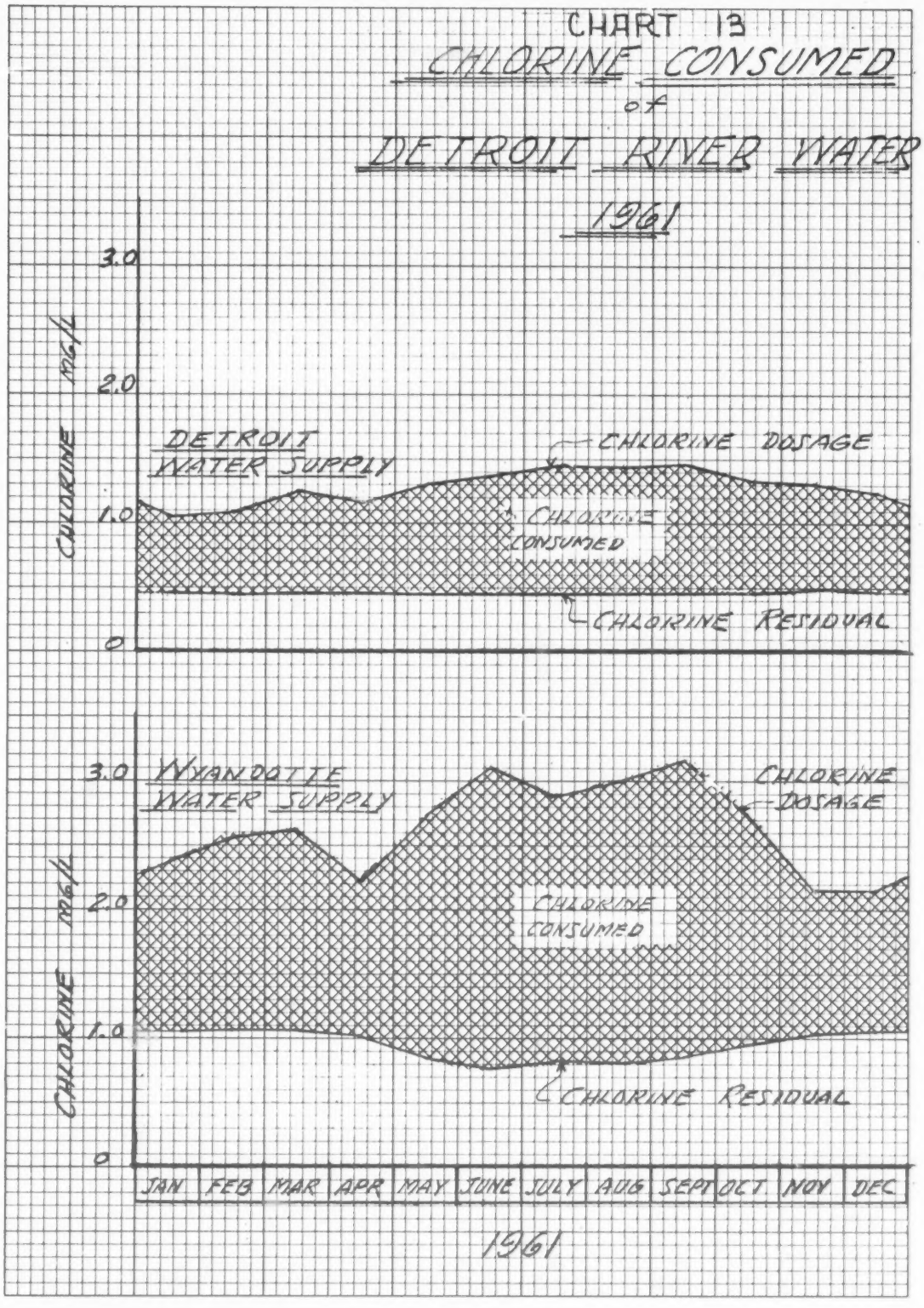


CHART 13
CHLORINE CONSUMED
of
DETROIT RIVER WATER
1961
3.0
2.0
1.0
0
CHLORINE MG/L
DETROIT WATER SUPPLY
CHLORINE DOSAGE
CHLORINE CONSUMED
CHLORINE RESIDUAL
WYANDOTTE WATER SUPPLY
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1961

chloroform extractable materials accumulated on the carbon are an index of certain trace organic constituents of the water, including some that cause taste and odor.

The median value of chloroform soluble organics at the Detroit water plant was 30 p.p.b. in 1961, with a maximum of 42 p.p.b. Comparable values at the Wyandotte plant were 60 and 107 p.p.b. The sewage and industrial wastes discharged to the Detroit River and tributaries above Wyandotte doubled the median value for the Wyandotte raw water and increased the maximum value by 2.5 times that at the Detroit plant.

Chlorides

Chlorides at the head of the Detroit River average about 7 mg/l. Near the mouth of the Detroit River average chlorides increase to about 20 mg/l, or nearly 3 times the concentration above Detroit. Sewage contributes to this increase, but the principal sources probably are 2 soda ash plants in Detroit. Chlorides as high as 90 mg/l have occurred in the source of water for plants situated along the lower Detroit River and have caused problems in processing water for boiler feed.

Hardness

The hardness of the raw water at the Highland Park water plant in Lake St. Clair averaged 102 mg/l during December, 1960, through November, 1961. The average hardness of the raw water at the Monroe water plant in Lake Erie during the same period

was 125 mg/l. This indicates a hardness increase of 23 mg/l, probably attributable to industrial wastes discharging to the Detroit River and tributaries. The 2 soda ash plants and other industrial plants using large quantities of lime probably were the principal contributors to the increase in hardness. The increased hardness requires additional quantities of soap and other detergents, for household use, and causes other less tangible effects in domestic use of the water. It also adds to the cost of water softening for industrial use.

Iron

Waste pickle liquor from steel manufacture contains high concentrations of sulfuric acid and iron. No serious effect of the large quantities of acid involved on the huge natural alkalinity resources of the Detroit River has been demonstrated. Once the acidity is neutralized, however, the iron is precipitated as fine orange to brown particles. These suspended particles discolor the water for variable distances below points of pickle liquor discharge, and decrease the aesthetic appeal of the water. The iron also discolors boat hulls and structures, such as bridge piers, submerged in the water.

Radioactive Wastes

There are several important users of radioactive materials and radioisotopes in the Detroit area. The waste disposal practices of the more important users were investigated and the records of

water monitoring in the area were reviewed. The waste disposal facilities and practices that were examined appeared to be adequate to prevent significant contamination of receiving waters. The results of water monitoring confirmed the fact that radioactive pollution of waters of the area is not a matter for concern.

SUMMARY AND CONCLUSIONS

A survey of pollution of the navigable intrastate portions of waters of Lake St. Clair, the Detroit River, and the western end of Lake Erie in the Detroit area was made during January and February, 1962, by personnel of the Public Health Service, Region V Office and the Robert A. Taft Sanitary Engineering Center. Existing information and data on sources of pollution, water uses, water quality, effects of pollution on quality, and damages and hazards to water uses were assembled and evaluated.

A continuing campaign to control pollution of these waters has been waged by state and local agencies, and material progress has been achieved in the provision of sewage and industrial waste treatment and control measures. Despite these achievements, however, adverse effects of pollution persist and additional control measures to protect the priceless water resources of the area are imperative.

The source of municipal water supply for the people of Wyandotte is subjected to contamination by upstream sewage treatment plant discharges and by storm water overflows which introduce raw sewage to the river. The resulting excessive bacterial

contamination poses an ever present threat to the safety of the treated water. Ammonia and other chlorine-consuming compounds discharged upstream cause rapid fluctuations in chlorine demand which require continuous vigilance and special treatment facilities to assure production of safe, potable treated water. A special treatment process is required to control phenolic tastes.

Recreational users of the waters below Belle Isle are exposed to the health hazards of excessive bacterial contamination. Swimming is not permitted along the Detroit waterfront, below Belle Isle, and Sterling State Park Beach has been closed because of bacterial contamination. Down river recreational development is handicapped. Despite the health hazards involved, thousands of pleasure boaters and hundreds of water skiers use the waters of the lower Detroit River. Sections of the waters along the shore lines of St. Clair, Macomb, and Monroe counties probably are rendered hazardous by the discharge of raw or inadequately treated sewage from shore homes. Raw sewage from more than a hundred storm water overflows throughout the area adds to the hazards of bacterial contamination, and produces visual nuisances on the surface of the waters.

Oil from industrial sources, some probably transmitted through municipal sewers, has killed ducks from time to time, fouled boats, and caused unsightly scum on the water in scattered areas. Most of the oil pollution apparently results from oil leaks and spills. Phenols still exceed the limiting

objectives that have been established, especially in the lower Detroit River. High densities of sludge worms on the bottom of the Detroit River in some areas indicate the existence of organic sludge deposits, and the replacement of desirable bottom life with pollution tolerant forms. Suspended solids cause changes in appearance of the water below certain sewage and industrial waste discharges which diminish the aesthetic appeal of the water.

Calcium chloride and lime wastes increase the hardness of Detroit River water by nearly 20 per cent, and chloride wastes have caused problems in processing water for boiler feed. The iron in waste pickle liquor discolors the water and coats boat hulls and submerged structures below points of discharge.

The need for certain improvements is obvious, but others probably should await further investigation. The Dearborn raw sewage and the unchlorinated primary effluent should be eliminated from the River Rouge as rapidly as possible. Improved bacterial control is needed at the Detroit Sewage Treatment plant. The Wayne County and Trenton sewage treatment plants are badly overloaded, and should be expanded, with the inclusion of improved means of bacterial control. Shore front communities in all 4 counties with water frontage should provide community sewerage systems with adequate treatment. Positive thinking leading to a positive approach to the problem of minimizing storm water overflow effects should be initiated. The precedent established by the installation of storm water overflow treatment plants,

providing sedimentation and chlorination, at Farmington and in the Milk River Drainage District, may constitute an important step in this direction. More attention should be devoted to prevention of oil spills and leaks by industry.

Some of the problems requiring further study are obvious. Studies of all important sources of industrial wastes should be undertaken so that evaluation of any effect of pollution attributable to each can be made and acted upon. The over-all effects of storm water overflows, as compared with and superimposed upon the effects of continuous discharges of treated effluents, should be evaluated. The extent and nature of sludge deposits and their impact on bottom organisms which serve as a link in the fish food chain should be investigated. The sources of bacterial contamination of the water along Sterling State Park Beach should be identified, so that correction may be made and the beach reopened as soon as possible. This involves special quantitative study of the possible fecal nature of coliform bacteria in the wastes of the strawboard mill at Monroe. The effects of sewage from shore front homes on bacterial quality of water along the private beaches and adjacent areas should be investigated. More thorough evaluation should be made of the effects of chlorides, hardness, and waste pickle liquor on water quality and uses. The impact of pollution of the Detroit River on water quality in Lake Erie should be determined.

It is obvious that pollution of the American waters of

Lake St. Clair, the Detroit River and the western end of Lake Erie constitutes pollution of navigable intrastate waters subject to enforcement under the provisions of the Federal Water Pollution Control Act (33 USC 466, etc.), as such pollution causes hazards to health or welfare of persons using these waters.